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Volume II

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ABSTRACT

The Sandia National Laboratories/New Mexico Facilities and Safety Information Document describes specific attributes of SNL/NM facilities and the environmental, safety, and health aspects of the operations within those facilities. The Sandia National Laboratories/New Mexico Facilities and Safety Information Document presents the following:

- An overview of SNL facilities and infrastructure.
- An overview of the programs that help to ensure the safety and health of workers, to protect the environment, and to protect SNL/NM assets.
- Information about the purpose, operations, hazards, hazard controls, and occurrences at relevant facilities and risk management methods for SNL/NM facilities that merit DOE-specified safety measures in their design and operation.
- Information on current activities that SNL/NM programs pursue at relevant facilities.
- Projections for a set of "selected" and infrastructure facilities with regard to alternatives for activities, inventories, material consumption, emissions, wastes, and resource consumption.

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READER'S GUIDE

The *Sandia National Laboratories/New Mexico Facilities and Safety Information Document* provides information about facilities, infrastructure, and programs at SNL/NM.

Chapter 1, "General Site and Facility Information," contains information on the following:

- Site history and setting
- "Notable," "selected" and "infrastructure" facilities and the criteria for identifying them
- Sources of information on SNL facilities from which the *Sandia National Laboratories/New Mexico Facilities and Safety Information Document* draws its content
- General information about SNL/NM facilities, including locations and demographics

Chapter 2, "Planning and Management of Assets at SNL/NM Facilities," describes the programs that help to plan, manage, and protect SNL/NM physical assets.

Chapter 3, "Safety, Health, and Environmental Protection at SNL/NM Facilities," describes the programs that help to protect the health and safety of workers and to protect the environment.

Chapter 4, "Notable Facility Reports," provides more detailed information for a subset of 13 facilities that the SNL sitewide environmental impact statement (SWEIS) support project staff identified as "notable." The kinds of information for each notable facility in Chapter 4 include the following:

- Purpose and need for each facility
- Description of each facility, including descriptions of structures and major equipment
- SNL/NM programs that use each facility
- Summary of operations at each facility

- Discussions of the hazards at each facility and the controls that are in place to mitigate or eliminate those hazards
- For each nuclear facility, moderate- and high-hazard nonnuclear facility, and accelerator facility, a discussion of the results of safety analyses drawn from existing safety documentation (safety analysis reports for nuclear and high-hazard nonnuclear facilities, safety assessments for moderate-hazard nonnuclear facilities, and safety assessment documents for accelerator facilities)
- Information on occurrences

Chapter 5 through Chapter 15 provide information on “selected” and “infrastructure” facilities. In designing their methodology for sitewide environmental impact analysis, DOE and its contractor decided to perform a detailed analysis of groups of selected SNL facilities that represent at least 90 percent of the SNL/NM operations that have the potential to cause significant environmental impacts. DOE also selected several infrastructure facilities for detailed information and analysis.

To support the sitewide environmental impact statement analysis, SNL projected and reported alternatives for activities, inventories, material consumption, emissions, wastes, and resource consumption for each infrastructure facility and for each facility within each selected facility group as follows:

- The “reduced alternative” represents the minimum levels of activities, inventories, material consumption, emissions, wastes, and resource consumption necessary to maintain the facility and equipment in an operational readiness mode and to ensure that there are sufficient staff with the knowledge, training, and hands-on experience to perform the operations.
- The “no action alternative” assumes that there are no program mission changes and represents continuation of activities, inventories, material consumption, emissions, wastes, and resource consumption in support of SNL/NM’s current missions. The no action alternative is broken out into three categories:
 - “No action base year,” which represents current levels of activities, inventories, material consumption, emissions, wastes, and resource consumption.
 - “No action 2003,” which represents a projection over the next five years of activities, inventories, material consumption, emissions, wastes, and resource consumption.

- “No action 2008,” which represents a projection over the next ten years of activities, inventories, material consumption, emissions, wastes, and resource consumption.
- The “expanded alternative” represents the highest levels of activities, inventories, material consumption, emissions, wastes, and resource consumption that the facility can support. This alternative may include multiple shift operations, some reconfiguration of equipment, and construction to modify existing buildings.

Chapter 5, “Summaries of Alternatives for Selected and Infrastructure Facilities,” summarizes the alternatives for activities, inventories, material consumption, emissions, wastes, and resource consumption for each infrastructure facility and for each facility within each selected facility group. The remaining chapters provide the same types of information for selected and infrastructure facilities as Chapter 4 provides for notable facilities, and these chapters also include detailed information on alternatives and assumptions for activities, inventories, material consumption, emissions, wastes, and resource consumption:

- Chapter 6, “Neutron Generator Facility Source Information”
- Chapter 7, “Microelectronics Development Laboratory Source Information”
- Chapter 8, “Explosive Components Facility Source Information”
- Chapter 9, “Advanced Manufacturing Processes Laboratory Source Information”
- Chapter 10, “Integrated Materials Research Laboratory Source Information”
- Chapter 11, “Physical Testing and Simulation Facilities Source Information,” which includes discussion of testing facilities in Tech Area III
- Chapter 12, “Accelerator Facilities Source Information,” which includes discussion of the accelerator facilities in Tech Area IV
- Chapter 13, “Reactor Facilities Source Information,” which includes discussion of the nuclear facilities in Tech Area V
- Chapter 14, “Outdoor Test Facilities Source Information,” which includes discussion of the testing facilities in Coyote Test Field

- Chapter 15, “Infrastructure Facilities Source Information,” which includes discussion of facilities that manage all of SNL/NM’s hazardous, radioactive, and mixed wastes

ACRONYMS, INITIALISMS, AND ABBREVIATIONS

mCi - micro-Curie(s)

mg - microgram(s)

mm - micrometer(s)

AC - alternating current

AEC - Atomic Energy Commission

AFWL - Air Force Weapons Laboratory

AHR - advanced hydrodynamic radiography

AICE - American Institute of Chemical Engineers

ALARA - as low as reasonably achievable

ALEC - Advanced Laser External Cavity

ANSI - American National Standards Institute

ASME - American Society of Mechanical Engineers

BDBA - beyond design-basis accident

BST - building source term

BTU - British thermal unit

CEDE - committed effective dose equivalent

CFR - Code of Federal Regulations

CHEST - Conventional High Explosives & Simulation Test (Chestnut Site)

CHNO - carbon, hydrogen, nitrogen, and oxygen (explosives)

Ci - Curie(s)

cm - centimeter(s)

CSPRA - Compact Short-Pulse Repetitive Accelerator

CTB - Cathode Test Bed

CTF - Coyote Test Field

CY - calendar year

DARHT - Dual-Axis Radiographic Hydrotest

DAS - data acquisition (system)

dB - decibel(s)

DBA - design basis accidents

DC - direct current

DIS - diagnostic instrumentation system

DoD - Department of Defense

DOE - Department of Energy

DOE/AL - Department of Energy/Albuquerque Operations Office

DOE/KAO - Department of Energy/Kirtland Area Office

DOT - Department of Transportation

DP - Defense Programs

dpm - disintegrations per minute

DU - depleted uranium

EBA - evaluation-basis accidents

EDE - effective dose equivalent

EOC - Emergency Operations Center

ER - environmental restoration

ES&H - environment, safety, and health

eV - electron volt(s)

FAIT - Facilities Asbestos Implementation Team

FHA - fault hazard analysis

FMEA - failure modes and effects analysis

FPAC - Firing Pad Access Control

fpm - feet per minute

fps - feet per second

FREC - Fuel Ringed External Cavity

ft - foot or feet

FTE - full-time equivalent

FY - fiscal year

g - gram(s)

gal - gallon

HA - hazards analysis

HC - hazard category

HEPA - high-efficiency particulate air (filter)

HERMES - High-Energy Radiation Megavolt Electron Source

HMX - octohyrotetranitrotetraozcine

HNAB - hexanitrostilbene

HVAC - heating, ventilation, and air conditioning

Hz - Hertz

IBEST - Ion Beam Surface Treatment

ICF - Inertial Confinement Fusion

ICS - instrumentation and control system

IEEE - Institute of Electrical and Electronics Engineers

IDLH - immediately dangerous to life and health

IMP - Intermediate Pulser

in. - inch(es)

ISMS - integrated safety management system

IST - initial source terms

IWFO - Intelligence Work for Others

J - joule

KAFB - Kirtland Air Force Base

kA - kiloampere(s)

kCi - kilo-Curie(s)

keV - kilo electron volt(s)

kg - kilogram(s)

kJ - kilojoule(s)

km - kilometer(s)

kW - kilowatt(s)

kV - kilovolt(s)

l - liter(s)

lb - pound(s)

LEVIS - laser evaporation ionization source

LEWS - Lightning Early Warning System

LIBORS - Laser Ionization Based on Resonant Saturation (System)

LICA - Low-Intensity Cobalt Array

LIVA - linear induction voltage adder

LMPL - Liquid Metal Processing Laboratory

LPF - leak path factor

m - meter(s)

MA - mega-ampere

MACCS - MELCOR Accident Consequence Code System

mCi - milli-Curie

MeV - mega electron volt(s)

mg - milligram(s)

mi - mile(s)

MITL - magnetically insulated transmission line

ml - milliliters

mm - millimeter(s)

MPC - microsecond pulse compressor

mrem - millirem

MSDS - material safety data sheet

MTA - Marx trigger amplifier

MTG - Marx trigger generator

MV - megavolt(s)

MW - megawatt(s)

NASA - National Aeronautics and Space Administration

NEC - National Electrical Code

NEPA - National Environmental Policy Act

NESHAP - National Emission Standards for Hazardous Air Pollutants

NEST - Nuclear Emergency Search Team

NFPA - National Fire Protection Association

NG - nitroglycerin

NHZ - nominal hazard zone

NIF - National Ignition Facility

NRU - neutron radiography unit

NSA - National Security Agency

NSTTF - National Solar Thermal Test Facility

ODMS - oxygen deficiency monitor system

OP - operating procedure

O&SHA - operating and support hazard analysis

OSHA - Occupational Safety and Health Administration

PBFA - Particle Beam Fusion Accelerator

PHS - primary hazards screening

PBX - plastic bonded explosives

PCB - polychlorinated biphenyl

PDFL - Photovoltaic Device Fabrication Laboratory

Pe - probability of event occurring per year

PETN - pentaerythritol tetranitrate

PFL - pulse-forming lines

PHS - primary hazard screening

PK1D - point kinetics, one-dimensional (thermal analysis code)

PMMA - Polymethyl methacrylate

ppm - parts per million

PPS - plant protection system

psi - pounds per square inch

PV - photovoltaic

RCF - refractory ceramic fiber

RCRA - Resource Conservation and Recovery Act

RCSC - Radiological and Criticality Safety Committee

RCT - radiological control technician

RDX - hexahydrotrinitrotriazine

Rf - radio frequency

RGD - radiation-generating device

RHEPP - repetitive high-energy pulsed power

RMMA - radioactive material management area

rpm - revolutions per minute

SABRE - Sandia Accelerator and Beam Research Experiment

SCB - steel confinement box

SDI - Strategic Defense Initiative

SGB - shielded glove box

SHA - system hazard analysis

SNL - Sandia National Laboratories

SNL/NM - Sandia National Laboratories/New Mexico

SNM - special nuclear material

SOP - standard operating procedure

SPHINX - Short-Pulse High Intensity Nanosecond X-Radiator

STAR - Shock Thermodynamics Applied Research Facility

STB - steel transfer box

STF - Subsystem Test Facility

STP - storage/transfer pool

SWEIS - sitewide environmental impact statement

TATB - triaminotrinitrobenzene

TNT - trinitrotoluene

TW - terawatt(s)

UL - Underwriters Laboratory

UNO - United Nations Organization (hazard classification and compatibility group)

USQ - unreviewed safety question

UV - ultraviolet

V - volt(s)

VDL - vacuum diode load

VIS - vacuum insulator stack

WFO - Work for Others

YAG - yttrium aluminum garnet

GLOSSARY

Accelerator - An accelerator is a device that employs electrostatic or electromagnetic fields to impart kinetic energy to molecular, atomic, or subatomic particles and that is capable of creating a radiation field greater than 5 mrem/hr at 30 cm from the exterior of the device under maximum operating conditions.

Administrative control - Method of controlling employee exposure by job rotation, work assignment, or time periods away from the hazard.

Barrier (physical) - Any device or method that effectively prevents contact with a recognized hazard. Examples include railings, rope, fences, barricades, shields, enclosures, rubber mats, plastic and metallic guards, or elevation above 8 feet (i.e., guarded by height).

Basis for interim operation - A document demonstrating that SNL personnel can conduct facility operations at an acceptable level of safety before development of more detailed safety documentation as required by DOE 5480.22 and DOE 5480.23 and before DOE approves that documentation.

Buddy system - Working with another person nearby who can provide immediate assistance if necessary.

Chemical - Any element, chemical compound, or mixture of elements and/or compounds.

Confined space - A confined space is a space which:

- Allows personnel to bodily enter and perform assigned work.
- Has limited or restricted means for entry or exit.
- Is not designed for continuous human occupancy.

Controlled access area - Access to onsite roadways is controlled if temporary or permanent physical access control barriers are provided. Examples of physical barriers include fences, DOE- or contractor-controlled guard gates, and security roadblocks. Passive barriers, such as signs, do not provide controlled access.

Corrosive material - A chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact. For example, a chemical is considered to be corrosive if, when tested on the intact skin of albino rabbits by the method described by the U.S. Department of Transportation in Appendix A to 49 CFR Part 173, it destroys or changes irreversibly the structure of the tissue at the site of contact following an exposure period of four hours. This term does not refer to action on inanimate surfaces.

Electrical hazard - Includes, but is not limited to, parts of electrical circuits operating at 50 volts or greater that are not guarded to protect personnel from accidental contact.

Electrical worker - A qualified person assigned to electrical or electronic work who uses electrical equipment or instruments other than hand tools or typical office equipment.

Environmental checklist/action description memorandum - The environmental checklist/action description memorandum communicates the “first order” environmental considerations to be included in the decision-making process and serves as a planning tool for evaluating potential environmental impacts prior to committing SNL to a course of action. It is also used to determine if an environmental assessment or an environmental impact statement is necessary.

ES&H standard operating procedure (ES&H SOP) - A document used to help plan the conduct of hazardous activities by describing the activity, the associated hazards, and the mitigation of those hazards. ES&H SOPs are intended for use by one or more organizations.

Event - An incident, situation, or condition that has or may have an undesirable effect on the safety or health of people, or on the environment.

Explosive - Any chemical compound or mechanical mixture that, when subjected to heat, impact, friction, shock, or other suitable initiation stimulus, undergoes a very rapid chemical change that creates large volumes of highly heated gases that exert pressures in the surrounding medium. This term applies to materials that either detonate or deflagrate. Explosives include primary and secondary explosives, propellants, and pyrotechnics. SNL does not regulate household materials such as matches or gasoline as explosives.

Explosive waste - Any explosive substance, article, or explosive-contaminated item that cannot be used for its intended purpose and does not have a legitimate investigative or research use. Examples include:

- Unstable explosive substances or articles
- Wipes, filters, or debris contaminated with explosives
- Scraps, cuttings, chips, fines, etc. from plastic, composite, or sheet explosives
- Explosives dissolved in solvents
- Damaged or misfired explosive articles
- Small quantities of bulk explosives, pyrotechnics, and propellants for which there are no known reapplication uses

Any of the above examples that have an investigative or research use are not waste until the owner determines that there is no further legitimate need or use for them.

Facility - Any equipment, structure, system, process, or activity that fulfills a specific purpose. Examples include accelerators, storage areas, fusion research devices, nuclear reactors, production or processing plants, coal conversion plants, magnetohydrodynamics experiments, windmills, radioactive waste disposal systems and burial grounds, environmental restoration activities, testing laboratories, research laboratories, transportation activities, and accommodations for analytical examinations of irradiated and nonirradiated components.

Facility electrical distribution system - Includes transformers, panel boards, receptacles (wall outlets), switches, and other pieces of equipment that are permanently wired into the facility electrical distribution system and that are not specifically identified as “user” equipment.

Fissile material - Any material consisting of or containing one or more of the fissile radionuclides, which are plutonium-238, -239, and -241 and uranium-233 and -235. Neither natural nor depleted uranium is a fissile material. Fissile materials are classified according to the controls needed to provide nuclear criticality safety during storage and transportation.

Flammable liquids - Liquids that vaporize at relatively low temperatures, that can easily ignite at room temperatures, and that have a flash point lower than 100°F.

General-use facilities - General-use facilities are those facilities containing hazards routinely encountered and accepted by the public, such as automobile repair shops, university laboratories, gasoline stations, and paint and hardware stores. Standard office facilities generally pose lower hazard levels than those presented by general-use facilities and are not classified as general-use facilities except under special circumstances.

Hazard - The likelihood that an adverse effect will result from a given set of exposure conditions.

Hazardous chemical - A chemical which presents a physical hazard or health hazard.

Hazardous waste - Waste that meets the definition of a solid waste and meets any one of the following conditions: exhibits, on analysis, any of the characteristics of a hazardous waste; has been named as a hazardous waste and listed as such in 40 CFR 261; is a mixture containing a listed hazardous waste and a non-hazardous solid waste; is a waste derived from the treatment, storage, or disposal of a listed hazardous waste; or is not excluded from regulation as a hazardous waste.

Hazards analysis - A hazards analysis identifies the hazards associated with a process or operation, identifies available hazard controls, and evaluates the adequacy of these controls.

Hazards assessment document - The hazards assessment document is the basis for developing the emergency response plan for a facility or site. It considers accident initiators such as sabotage or terrorist attacks, which are not considered by the safety analysis process.

Incompatible waste - The concept of incompatibility refers to the spontaneous interaction between chemicals or chemicals and materials that can harm human health or the environment through:

- Violent reactions
- Release of toxic or flammable fumes
- Fire or explosion
- Evolution of heat and pressure

Mixed waste - Mixed waste is any solid waste that contains both a hazardous waste component, as defined in the *Resource Conservation and Recovery Act* and implementing regulations, and a radioactive waste component, as defined in DOE orders.

A state may define additional waste as hazardous waste, thus causing other hazardous and radioactive waste mixtures to be regulated by the state as mixed waste.

Mixed waste generator - A mixed waste generator is any person or organization generating mixed waste or causing a material to be subject to mixed waste regulations. Generators are responsible for the generation and subsequent management of mixed waste as part of their occupation or position. Generators may include managers, their employees, and contractors.

Net explosive weight - The weight of an explosive itself or an explosive contained within an ordnance item or device.

Nonnuclear facilities, high-hazard - High-hazard nonnuclear facilities are those with the potential for onsite or offsite impacts on large numbers of people or for major offsite impacts on the environment.

Nonnuclear facilities, low-hazard - Low-hazard nonnuclear facilities are those that present minor onsite impacts (within the boundaries of SNL-controlled areas) and negligible offsite impacts (outside the boundaries of SNL-controlled areas) to people or the environment. Low-hazard nonnuclear facilities or operations may present:

- Significant damage to the experiment or operational area (temporary loss of the use of the equipment or facilities).
- Minor injury to the workers involved in the activity, including exposures that are unlikely to produce more than minor injury or temporary discomfort (for example, cuts, bruises, and minor burns).
- Negligible (unmeasurable) injury to workers not involved in the project or activity and offsite people.
- Negligible impact to the offsite environment (outside the boundary of SNL-controlled areas).

Nonnuclear facilities, moderate-hazard - Moderate-hazard nonnuclear facilities are those that present considerable potential onsite impacts to people or to the environment but only minor offsite impacts, at most.

Nonpermit confined space - A nonpermit confined space is a space which meets the definition of a confined space, but after evaluation, is found to have minimal potential for hazards. This type of confined space requires an entrant to complete a nonpermit confined space checklist.

Nuclear facility - A nuclear facility means reactor and nonreactor nuclear facilities, as defined in DOE 5480.23, that require the preparation of a safety analysis report.

Nonreactor nuclear facility means those activities or operations that involve radioactive and/or fissionable material in such form and quantity that a nuclear hazard potentially exists to the employees or the general public.

Included are activities or operations that:

- Produce, process, or store radioactive liquid or solid waste, fissionable materials, or tritium.
- Conduct separation operations.
- Conduct irradiated materials inspection, fuel fabrication, decontamination, or recovery operations.
- Conduct fuel enrichment operations.
- Perform environmental remediation or waste management activities involving radioactive materials.

Incidental use and generating of radioactive materials in a facility operation (e.g., check and calibration sources, use of radioactive sources in research and experimental and analytical laboratory activities, electron microscopes, and X-ray machines) would not ordinarily require the facility to be included in this definition. Accelerators and reactors and their operations are not included.

Reactor means, unless it is modified by words such as containment, vessel, or core, the entire reactor facility, including the housing, equipment, and associated areas devoted

to the operation and maintenance of one or more reactor cores. Any apparatus that is designed or used to sustain nuclear chain reactions in a controlled manner, including critical and pulsed assemblies, and research, test, and power reactors, is defined as a reactor. All assemblies designed to perform subcritical experiments that could potentially reach criticality are also to be considered reactors. Critical assemblies are special nuclear devices designed and used to sustain nuclear reactions. Critical assemblies may be subject to frequent core and lattice configuration change and may be used frequently as mockup of reactor configurations.

Occurrence - An occurrence is a problem, concern, failure, malfunction, or deficiency in equipment, process, procedure, or program. It is also any condition or event that could have an adverse effect on safety, the environment, health, security, or operations. Occurrences may, or may not, be reportable to DOE depending on their level of seriousness. Occurrences are reportable to DOE if they are determined to be:

- Emergency
- Unusual
- Off-normal

Operating procedure - An operating procedure (OP) is a document that provides step-by-step instructions for specific operations (normal, postulated abnormal, and emergency operations) to ensure that activities are performed correctly, safely, and consistently. Typically, organizations develop their own OPs for internal use within the organization. OPs may exist as independent documents, unless they describe operations involving hazards which require the development of environment, safety, and health standard operating procedures (ES&H SOPs). OPs may not substitute for ES&H SOPs, although they may supplement them.

Operational safety requirements - Operational safety requirements define the operating limits of facility, operation, or activity control parameters for nonnuclear facilities that can pose a risk to the public. Operational safety requirements are included in the facility safety documentation.

Overpack - An enclosure other than a freight container that protects or facilitates handling of a package, or consolidates two or more packages.

Permit, confined space entry - A written document that authorizes and controls entry into a permit-required confined space. The permit specifies the hazards of the confined space and outlines the controls required for entry.

Permit-required confined space - A permit-required confined space is a space which meets the definition of a confined space, and after serious evaluation, has actual or potential hazards which have been determined to require written authorization for entry. This type of confined space requires a confined space entry permit and an attendant to be present during entry activities.

Primary container - The container in which the waste will remain when it is removed from the generator's satellite.

Primary hazard screening (PHS) - An electronic, online software process to determine the hazard level and identify hazards of a facility, activity, or operation. Primary hazard screenings also identify training and regulatory requirements.

Radioactive source - Radioactive material or equipment containing radioactive material that spontaneously emits ionizing radiation put to some purpose.

Radioactive waste - Solid, liquid, or gaseous material that contains radionuclides regulated under the *Atomic Energy Act of 1954*, as amended, and is of negligible economic value considering costs of recovery. Examples of common radioactive waste includes depleted uranium, activated materials, fission products, and tritium-containing waste.

Radioactive waste generator - Any person or organization generating radioactive waste or causing a material to become radioactive waste intentionally or under unplanned circumstances. Generators may include: managers, other SNL employees, and contractors who are responsible or potentially may be responsible for the generation and subsequent management of radioactive waste as a part of their occupation or position.

Radiologically controlled area - A radiologically controlled area (RCA) is an area to which access is controlled to protect personnel from exposure to radiation and radioactive material.

Release to the environment, oil - Any amount of oil, grease, or fuel that enters a building drain or reaches the earth or water outside a building wall or secondary containment.

Reportable quantity - Quantity of material or product compound or contaminant which, when released to the environment, is reportable to a regulatory agency.

Safety analysis - A process that provides systematic identification of hazards within a given DOE operation, that describes and analyzes the adequacy of measures taken to eliminate or otherwise control identified hazards, and that analyzes and evaluates potential accidents and their associated risks.

Safety analysis report - The report that documents the adequacy of safety analysis for a facility to ensure that the facility can be constructed, operated, maintained, shut down, and decommissioned safely and in compliance with applicable laws and regulations.

Safety assessment - A safety assessment is an evaluation and risk analysis of a nonnuclear facility to determine its level of risk and the need for a safety analysis report. A safety assessment systematically:

- Identifies the hazards of a facility.
- Describes and analyzes the adequacy of measures taken to eliminate or otherwise control identified hazards.
- Analyzes and evaluates potential accidents and their associated risks.

Safety assessment document - A safety assessment document contains the results of a safety analysis for an accelerator facility or one of its constituents. DOE 5480.25, *Safety of Accelerator Facilities*, uses the label "safety assessment document" to distinguish this type of documentation from the safety analysis report for nuclear and high-hazard nonnuclear facilities.

Secondary containment - Any structure or device that has been installed to prevent leaks, spills, or other discharges of stored chemicals, waste, oil, or fuel from storage, transfer, or end-use equipment from being released to the environment. Examples of secondary containment include pans, basins, sumps, dikes, berms, or curbs.

Site - A specific SNL-controlled area of land upon which SNL controls access and egress, such as those locations in Albuquerque, Livermore, or Tonopah. A site is an area of land that contains a DOE facility or facilities that are either owned or leased by DOE or the federal government. The land may be divided by public right-of-ways.

SNL personnel - SNL employees and Sandia-directed contractors (contract personnel who work under a contract for which SNL retains accountability for the outcome of the work and whose work is routinely directed by SNL employees).

Spill - Any uncontained release of a hazardous material into the environment, including releases into a secondary containment unit. Spill, release, and leak are synonymous when appropriate.

Spill, oil - Any unplanned release of a petroleum product in any amount.

Standard industrial hazard - A facility or project activity that has hazards of the type and magnitude that are routinely encountered and/or accepted by the public in everyday life. This includes hazardous materials or operations encountered in general industry in appropriate applications that are adequately controlled by Occupational Safety and Health (OSHA) regulations or one or more national consensus standards (e.g., ASME, ANSI, NFPA, IEEE, NEC). This would apply where these standards are adequate to define special safety requirements, unless in quantities or situations that could significantly impact large numbers of people. In the event a facility or project activity receives a hazard classification of standard industrial hazard (SIH), the primary hazard screening (PHS) itself will be the necessary and sufficient level of safety documentation.

Technical safety requirements - Technical safety requirements are conditions, safe boundaries, and management and administrative controls that are necessary to ensure the safe operation of a nuclear facility and to reduce the potential risk to the public and facility workers from uncontrolled releases of radioactive materials or from radiation exposure due to inadvertent criticality.

The elements of a technical safety requirements document include:

- Safety limits
- Operating limits
- Surveillance requirements
- Administrative controls
- Use and application instructions and the bases thereof

CHAPTER 11 - PHYSICAL TESTING AND SIMULATION FACILITIES

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1.0 INTRODUCTION

SNL has constructed and operated test facilities as one of the technical activities to achieve their primary mission of ensuring that the nation's nuclear weapons systems meet the highest standards of safety and reliability. These facilities have been specifically designed for the validation of analytical modeling and the functional certification of weapons systems.

Planning for Tech Area III began in 1952 in response to a need for a full-scale environmental testing capability of weapons that included use of explosives but that did not involve nuclear detonation. This required a centralized outdoor test location, complex equipment, and specialized engineers. A centrifuge, a rocket sled track, a vibration testing facility, and a control center were completed in 1953. Additional facilities were constructed between 1954 and 1960.

Tech Area III incorporates four principal testing facilities:

- Sled Track Complex
- Centrifuge Complex
- Drop/Impact Complex
- Terminal Ballistics Facility

A variety of equipment and facilities such as sensors, audio-visual equipment, measuring and monitoring devices, a control center, and material and equipment storage structures support work at Tech Area III. Most of the testing at the facilities is conducted outdoors and involves various methods for accelerating and impacting test packages at high speeds. The tests may be performed with or without explosive material.

2.0 SLED TRACK COMPLEX SOURCE INFORMATION

2.1 Purpose and Need

The Sled Track Complex is an SNL test facility for simulating high-speed impacts of weapon shapes, substructures, and components to verify design integrity, performance, and fuzing functions. The facility also subjects weapon parachute systems to aerodynamic loads to verify parachute design integrity and performance. It is also used by SNL Energy and Environment programs to verify designs in transportation technology, reactor safety, and DP transportation systems. The DOE needs the Sled Track Complex to support research and development activities in the national interest on an as-available basis.

(Bomber *et al.*, 1996)

2.2 Description

The Sled Track is a 10,000-ft concrete beam supporting two continuously welded steel crane rails at a 22-in. gauge. There is a 1-ft square trough cast in the concrete beam between the rails. The trough can be filled with water, which is engaged by scoops on recoverable sleds. The water depth is controlled to generate a constant braking force (the depth of water engaging the brakes is increased as the sleds decelerate).

The 10,000-ft sled track was originally constructed in 1966 as a 5,000-ft track to replace a 3,000-ft track that had been in operation since the early 1950s. It was extended to 10,000 ft in 1985 to provide additional accelerating distances for achieving higher test velocities.

The 3,000-ft sled track was inactive following construction of the 10,000-ft sled track. The rail from the north end of the track was removed in 1970 to construct a sled track at the Aerial Cable Complex. The remaining track is approximately 2,066 feet in length. This 2,000-ft sled track was put back in service in 1976. It, like the 10,000-ft sled track, is supported on a concrete beam. However, it has railroad rails at standard railroad gauge. This was a more attractive gauge for conducting impact tests of transportation systems such as tractor trailers and railroad equipment.

The 2,000-ft sled track is 3/4 mi east of the 10,000-ft sled track and is operated as an appendage to the 10,000-ft sled track.

A massive concrete structure was constructed across the north end of the 2,000-ft track, simulating a bridge abutment into which transportation equipment is impacted in severe accident scenarios. A second concrete structure was built at the south end of the track to support concrete panels representative of a reactor containment building structure. Threat missiles are impacted into these panels to verify containment building design integrity.

The Sled Track Complex includes a rocket launcher with a 70-ft launch beam. It is located just east of the south end of the 10,000-ft sled track and is used to launch test items into specific targets. The launch rail can be angled for launching test items down the beam to oblique impacts with targets.

A portable launcher consisting of a 10-ft beam mounted on a trailer is used at the Sled Track Complex to launch free-flight, rocket-powered parachute test vehicles.

Explosive operations were relocated from Thunder Range to the south end of the 10,000-ft sled track as an approved proposed action (U.S. Department of Energy, 1997).

The Sled Track Complex includes the following support buildings and structures:

- Building 6741 (control room, workshop, and highbay assembly area)
- Building 6736 (Sprint rocket disassembly)
- Building 6743 (explosives assembly and rocket motor thermal conditioning)
- Building 6742 (underground instrumentation bunker)
- Building 6743-A/B and Building 6747 (explosives storage magazines)
- Building 6744, Building 6745, and Building 6746 (optical instrumentation towers)
- Building 6751 (visitor observation tower)

(U.S. Department of Energy, 1997; West, 1997)

2.3 Program Activities

Table 11-1 shows the program activities at the Sled Track Complex.

Table 11-1. Program Activities at the Sled Track Complex

Program Name	Activities at the Sled Track Complex	Category of Program	Related Section of the SNL Institutional Plan
Direct Stockpile Activities	Conduct environmental, safety, and survivability testing for nuclear weapon applications.	Programs for the Department of Energy	Section 6.1.1.1
Performance Assessment Science and Technology	Provide environmental, safety, and survivability testing for nuclear weapon applications.	Programs for the Department of Energy	Section 6.1.1.1
Sustaining Critical Progress in Model Validation	Depending on the code being validated, the following types of tests would be performed: collision impact, reverse-impact, parachute deployment, dynamic weapon firing, and full-function weapon deployment tests.	Major Programmatic Initiatives	Section 7.1.3

Table 11-1. Program Activities at the Sled Track Complex (Continued)

Program Name	Activities at the Sled Track Complex	Category of Program	Related Section of the SNL Institutional Plan
All Other Reimbursables	Impact, functional, parachute and explosive effects testing.	Work for Non-DOE Entities (Work for Others)	Section 6.2.8
Energy Programs	Certify designs in transportation technology and reactor safety.	Major Programmatic Initiatives	Section 7.2.1

2.4 Operations and Capabilities

Operations at the Sled Track Complex include conducting rocket sled, rocket launcher, and explosive tests, which involve the following support activities:

- Receival, storage, and handling of explosives, pyrotechnics, and propellants
- Receival, storage, and handling of nuclear, radioactive, and chemical materials
- Fabrication and assembly of rocket sleds
- Mating of sleds, payloads, and rockets
- Setting up explosive tests
- Pressurizing sled pneumatic ejectors
- Laser tracking
- Photometrics
- Telemetry
- X-ray
- Hazard area control
- System checking fire-control system
- Transporting launch assemblies to launch sites
- Electronic instrumentation and data recording
- Rocket arming and launching
- Radioactive and chemical material recovery
- Explosive arming and firing
- Abort procedures
- Misfire procedures
- Post-launch and firing procedures
- Explosives ordnance disposal
- Transporting explosive assemblies to firing sites

The types of tests conducted at the Sled Track Complex include:

- **Impact Tests** - Test objects are built into expendable sled structures and rocket-accelerated into specific targets at the end of the sled track. The rockets may be on the expendable sleds and impact the targets with the test articles or they may be on pusher sleds that are water-braked after rocket burnout while the expendable sleds and test articles go on to impact the targets. Impact velocities are controlled by modeling sled trajectories by computer. The models determine rocket motor impulse and launch position on the track relative to the impact point that will yield the desired impact velocities. As many as 30 smaller rocket motors (HVARs, Zuni, Super Zuni) or 4 larger rocket motors (Nikes) could be required, depending upon the mass of the test objects and planned impact velocities, which range from subsonic to Mach 6. Response data are telemetered from test articles to ground station recorders. Target response data are recorded directly by hard wire. Impact events are recorded by high-speed framing cameras and flash x-ray.
- **Reverse Ballistic Impact Tests** - Target materials are built into expendable sled structures and rocket-accelerated to impact test objects at the end of the track. The rocket motors impact the target with the target sleds. These are usually supersonic tests requiring large rocket motors (Nikes or first-stage Sprints). Response data are recorded directly by hard wire, yielding more channels of higher response data than possible through telemetry. Impact events are recorded by high-speed framing cameras and flash x-ray.
- **Free-Flight Impact Tests** - Test objects are ejected from recoverable rocket sleds by pneumatic ejectors built into the sleds. Sled velocities at ejection and ejection energies are programmed to result in ballistic trajectories that place the test objects onto specific targets such as simulated runways. Up to 30 Zuni rocket motors, 3 Nike rocket motors, or a second-stage Sprint rocket motor may be required, depending upon the mass of the test objects and impact velocities. The rocket sleds are recovered by water brakes after the test objects are ejected. Laser trackers record trajectory data, and response data are telemetered from test objects to ground station recorders. High-speed framing cameras record impact events.
- **Function Tests** - Test objects are rocket-accelerated down the track on recoverable sleds, ejected from the sleds into free flight, or launched into free flight from portable launch rails to verify functions programmed to occur during the tests. The rocket propulsion required is similar to that of free-flight impact tests. Free-flight launches are preferred over sled tests because they require less manpower and use a single rocket motor (HVAR or Zuni). Thus, a number of free-flight tests could be conducted per day, while a sled test usually takes two days per test. Telemetry, laser tracking, and high-speed framing cameras verify functions.

- **Parachute Tests** - Parachute tests are function tests in which the functions are the deployment of parachutes at specified dynamic pressures. Parachute deployments may also be a function during free-flight impact tests.
- **Rocket-Launcher Impact Tests** - Test objects are rocket-accelerated down a beam on a carriage that is stopped at the end of the beam, allowing the test objects to free fly into specific targets at predetermined impact angles and velocities. Impact velocities are relatively low due to the short launch distance. Two rocket motors (HVARs or Zunis) are usually required to accelerate the carriage. Explosive devices restrain the carriage until the planned release time. The advantage of this technique over sled track impacts is the ability to achieve oblique impacts. Response data recording by hard wire is possible because of the short accelerating distances. High-speed framing cameras record impact events.
- **Explosive Effects Tests** - Explosive charges are detonated at an explosive firing site located south of the 10,000-ft sled track. The explosive detonations subject test objects to blast waves or propel missiles into test objects. The explosive charges are typically C4, TNT or HMX. Response data are recorded by hard wire. High-speed framing cameras and flash x-ray record effects.

(U.S. Department of Energy, 1997; West, 1997)

2.5 Hazards and Hazard Controls

2.5.1 Explosive Materials

2.5.1.1 Hazards

The principle hazard associated with explosives, pyrotechnics, and propellants is the accidental detonation or deflagration of energetic materials. Explosive components may be sensitive to heat, mechanical shock, static electricity, fire, or electromagnetic radiation.

During sled assembly operations, track personnel are in close proximity to these energetic materials. Accidental ignition, deflagration, or detonation could cause severe injury or loss of life for multiple personnel.

2.5.1.2 Hazard Controls

Written environment, safety and health (ES&H) standard operating procedures (SOPs) are utilized for all handling of explosive materials. All personnel involved in a given activity are required to read and follow applicable ES&H SOPs if they are to work with explosive materials.

All activities relating to the shipping and receiving of explosive materials are conducted in accordance with applicable DOE requirements, including U.S. Department of Energy (1996). ES&H SOPs include requirements for the use of grounding straps, properly approved electrical equipment, access control, and other physical and administrative controls.

2.5.2 Nuclear and Radioactive Materials

2.5.2.1 Hazards

Nuclear and radioactive materials associated with testing at the Sled Track Complex include special nuclear material, depleted uranium, uranium alloys, thorium alloys and compounds, and tritium. These materials are always contained in sealed, weaponized assemblies when delivered to the Sled Track Complex and are not opened during sled assembly. Tests involving special nuclear material are conducted at velocities below the threshold of structural failure of the sealed weapon assemblies. The most common radioactive material utilized is depleted uranium, which has a very low specific activity (1.0 μCi per g). A typical weapon assembly may contain depleted uranium that produces gamma radiation at the case surface of up to 1 mR per hour. However, track personnel have relatively short exposures to these assemblies during integration and testing. Annual radiation exposure to track personnel is not expected to exceed 100 millirems per year. On this basis, facility personnel are not required to wear thermoluminescent dosimeters. All radiation exposures conform to the requirements of 10 CFR 835, *Occupational Radiation Protection*, and DOE O 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees*.

2.5.2.2 Hazard Controls

Either the Explosives Storage Team or the Nuclear/General Material Storage Team delivers assemblies and components with radioactive materials to the Sled Track Complex. These assemblies are checked for radioactive surface contamination by trained health physics personnel who conduct swipe tests of the shipping container, if used, and the test unit. In addition, these personnel measure the average magnitude of gamma emission from the test unit, both at the surface and at a nominal distance of 1 m.

In order to ensure nuclear safety, all test units with accountable quantities of nuclear material are also carefully measured by gamma spectroscopy and neutron fluence to verify the exact identity of nuclear material. The nuclear verification is performed immediately after receipt of the test unit at the Sled Track Complex.

2.5.3 Chemical Materials

2.5.3.1 Hazards

Small amounts of chemicals are used in assembling rocket sleds and test payloads in Building 6741, Building 6743, and Building 6736. For example, various adhesives and epoxies are used to fasten transducers and similar items.

Cleaners, lubricants, solvents, paints, and agents that might be used in small quantities include the following:

- Methyl alcohol
- Methyl ethyl ketone
- Acetic acid
- Ethylene glycol
- Potassium hydroxide
- Trichlorethylene
- Acetone
- Freon TMS
- Sodium hydroxide
- Ethyl alcohol
- Isopropyl alcohol

Compressed gases in the assembly areas include the following:

- Acetylene and oxygen for welding
- Dry nitrogen and carbon dioxide for pneumatic actuators
- Argon
- Helium

2.5.3.2 Hazard Controls

Chemical usage is small. Chemicals are in 1-gal containers or less. Standard procedures outlined in Sandia National Laboratories (1999) dictate that the amount of chemicals present in the assembly areas at any one time be limited to the minimum amount needed for the performance of the work. All chemicals are stored in approved chemical storage cabinets when not in use.

Compressed gases are stored in DOT-approved compressed gas cylinders and are used in accordance with Shrouf (1995).

2.5.4 Fabrication and Assembly of Rocket Sleds

2.5.4.1 Hazards

Sled fabrication and assembly operations involve a full spectrum of hazards from standard shop industrial hazards to high explosives. Hazards encountered during fabrication and assembly of mechanical, pneumatic, and electrical components involve industrial accidents, hoisting and lifting accidents, electrical shock, high-pressure accidents, and accidental deflagration or explosion of energetic materials.

2.5.4.2 Hazard Controls

Fabrication of sled mechanical components is performed on standard industrial machines in the Building 6741 workshop and highbay. SNL and contractor personnel utilizing these machines must first have classroom training on each type of machine employed. Machine guarding safety shields and operator personal protective equipment (PPE) is required and utilized as specified in Sandia National Laboratories (1999).

Crane utilization and hoisting and lifting operations are performed only by SNL and contractor personnel who have attended RGH-100. Utilization, inspection, and periodic maintenance of cranes and hoists in Center 9100 is specified by Chapter 4, Section J of Sandia National Laboratories (1999).

Electrical shock hazards, high pressure hazards, and explosive hazards are mitigated, in part, by specific training designed to cover each generic type of hazard. Bundy (1996) specifies training for electrical safety; Shrouf (1995) specifies training for activities involving pressurized systems; and U.S. Department of Energy (1996) and Dotts (1996) both specify training requirements for explosives hazards. The use of ground-fault circuit interrupters,

double-insulated power tools, and grounding/bonding techniques mitigate electrical shock hazards during shop operations wherever possible.

The explosives-related assembly highbays of Buildings 6736 and 6743 were constructed to explosive safety standards of Class 2, Division 2, Group G to accommodate solid-fuel rocket motors and cased explosives. Workbench surfaces have conductive coatings connected to the building internal ground bus. Personnel involved in explosives-handling operations wear solid conductor wrist straps connected to the ground bus, and all explosive components are also bonded to this ground whenever possible.

Lightning protection systems are incorporated on all buildings at the Sled Track Complex to warn personnel involved with explosives-handling operations of a potential lightning strike.

All assembly and checkout activities involving the hazards identified above are specified and controlled by ES&H SOPs written to cover each specific hazard as it is encountered in the operation or activity. Hazards unique to a sled test payload are covered by assembly procedures. Hazards generic to the sled assembly and test facility such as high-pressure ejectors, firesets, and rocket motors are covered by technical work documents written by the Albuquerque Full-Scale Experimental Complex Department.

2.5.5 Mating Rocket Sleds, Payloads, and Explosives

2.5.5.1 Hazards

The primary hazards encountered during the sled, payload, and rocket motor mating are related to accidental ignition of the rocket motors or detonation of payload explosives components. Secondary hazards are presented by pressurizing sled ejection mechanisms, charging payload batteries, and checkout of on-board telemetry or electrical systems. Other hazards associated with this activity would be falling or tripping from elevated work platform or ladders utilized during the mating and track rail mounting process and load-dropping accidents with cranes, hoists, or forklifts during mating and transportation to the track.

2.5.5.2 Hazard Controls

All of the controls described above for the assembly operations apply to the mating process. Crane utilization, hoisting, and rigging are especially sensitive when lifting rocket motors and payload assemblies that contain explosives and chemical hazards. Only experienced and qualified track personnel operate these cranes and other lifting equipment, such as forklifts.

Shorting, grounding, and bonding electrical connections to initiators, using personal wriststraps, and maintaining a static-free environment during explosives-handling operations are all intrinsic and fundamental requirements of operational ES&H SOPs. Monitoring of the lightning early warning system is also a mandatory requirement of all track procedures. All explosive activities are terminated when the potential gradient reaches 2,000 volts per meter.

2.5.6 Explosive Test Setup

2.5.6.1 Hazards

The primary hazard encountered during explosive test setup is the accidental detonation of the explosives. Other hazards associated with this activity would be load-dropping accidents with cranes, hoists, or forklifts during the transportation to and setup at the explosive firing site.

2.5.6.2 Hazard Control

All of the controls described above for the mating of sleds, payloads, and rockets apply to the setting up of explosives.

2.5.7 Laser Tracking

2.5.7.1 Hazards

The laser tracker is a specialized optical measurement system to measure the precise trajectory of rocket sleds and missiles and to simultaneously record documentary photography of their performance. The laser tracker has sufficient optical energy to present an eye damage hazard or a skin damage hazard to personnel exposed to the beam at close ranges. Table 11-2 shows the nominal optical hazard distances calculated during tracking operations, with the smallest beam divergence of 2 milliradian (the most dangerous case).

Table 11-2. Nominal Optical Hazard Distances

Hazard	Nominal Optical Hazard Distance
Skin damage	21.3 ft
Eye damage (unaided viewing)	349 ft
Eye damage (reflected from balloon cloth)	82 ft
Eye damage (optically aided viewing)	28.7 mi

2.5.7.2 Hazard Controls

The tracker operator observes the pointed direction of the laser on two video cameras that display a magnified wide field of view and greatly magnified narrow field of view centered at the beam axis. A joy stick controller allows the operator to track the object to reestablish lock whenever auto tracking lock is lost. The combination of viewing and joy stick control is an important safety feature because it allows the operator to observe any situation in which the beam direction is of concern and redirect the beam to a safe position immediately.

During setup and operation at the Sled Track Complex, the laser is directed and locked onto a diffuse reflecting target along the track on either a setup target or the test object. The distance is more than 2,000 ft. This target acts as a partial beam stop and directs the laser to intercept the ground at a safe distance. During setup and normal operation, the laser beam is pointed from a location above the trailer located on a raised pad so that the beam is about 34 ft above the surrounding terrain near the laser tracker and reaches the ground at the distance to the track. Thus, the beam passes well overhead of anyone in the immediate vicinity of the laser tracker within the hazard range for intrabeam viewing. In addition, the beam is contained within the laser tracker, and access to the gimbal mount on top of the tracker is restricted by a lock on the ladder in the stowed position and an interlock that shuts off power if the ladder is unstowed.

During testing, the beam follows the test object until loss of lock. Depending upon the setup, the laser will either return to the point of loss of lock within a fraction of a second or, if trajectory prediction is used, the beam will follow a path that extrapolates the trajectory. The beam will come to a stop if lock is not reestablished. Depending upon the setup, the beam focus will be some where between 2 and 25 milliradian. Within a short period after completion of the test, the operator inserts beam stops at the laser output from the trailer.

The laser tracker positioning at the Sled Track Complex is such that the local work force is restricted to distances that are beyond the nominal optical hazard distance for direct viewing. The only possible damage mechanism is optically aided viewing with a good optical system from a position directly on axis of a stationary beam from a range of 2.3 mi or closer. The primary safety feature is the operator's view of the beam direction by video, allowing direction of a static beam to a safe ground intercept. In addition, the combination of the small area illuminated by the beam in comparison to the spherical area at 2.3 mi, the short time of exposure, the relatively low work for population within 2.3 mi of the event, and the low probability that optical aids would be used by the public leads to the assessment that an accident is extremely unlikely.

2.5.8 Telemetry and Photometrics

2.5.8.1 Hazards

Telemetry systems aboard rocket sleds and payload assemblies introduce hazards due to electrical sources of energy from batteries and due to the potential for cross wiring or “sneak circuits” that could accidentally fire an explosive initiator. Additional hazards are introduced by the chemical nature of the batteries themselves. Explosive gases may be created by charge or discharge actions, chemical spills of corrosive or acidic materials can occur, and the battery case can explode under certain conditions. Thermal batteries, when used, can present all of the above hazards plus a burn hazard to personnel. Personnel associated with telemetry receiving operations are located out of the controlled hazard area during tests.

Photometrics operations do not generally involve exposure of personnel to the test hazards. These personnel are located out of the controlled hazard area during tests.

Field setup of telemetry and photometrics instrumentation can involve industrial hazards, falling or tripping, electrical shocks from power distribution equipment, and weather-related hazards.

2.5.8.2 Hazard Controls

The hazards presented by incorporating on-board telemetry systems with systems that use explosives are potentially severe. For this reason, the explosives are installed as late as possible in the buildup and mating of the integrated sled and payload assemblies. Explosives ignitors are installed as late as possible in the buildup and then are disconnected and shorted during telemetry checkout. An ES&H SOP designed for this integration process contains a checklist designed for the step-by-step procedure, which is retained in the test log as a documentation of safety and proper functioning of the test assembly.

The final test of the on-board telemetry is made on the track at the launch position after the arming crew connects the rocket motor initiators to the launch control firing module. This test is performed remotely from the fire-control bunker after the arming crew has returned with the track console enable key. No power can be applied to the sled payload assembly without this key.

Hazards encountered during field setup of instrumentation are mitigated by safety training awareness on the use of ladders and platforms, foul-weather clothing, and multi-person teams in remote locations. Electrical shock hazards during field setup activities are mitigated by electrical safety training, use of ground fault circuit interrupters, double-insulated electric hand tools, and grounding/bonding techniques.

2.5.9 Hazard Area Control/Explosive Arming and Firing

2.5.9.1 Hazards

Personnel entering the hazard area of a test at the Sled Track Complex either deliberately or accidentally without the expressed knowledge and permission of the launch controller could be seriously injured or killed by blast, impact, or shrapnel. Low-flying aircraft could suddenly appear in the vicinity of the hazard area at launch time and be damaged by shrapnel or blast. The final arming crew is in close proximity to major sources of energetic materials during the arming procedure.

Accidental ignition of a rocket motor would almost certainly result in the serious injury or death of the crew members.

2.5.9.2 Hazard Controls

The hazard area footprint is based on the worst case, maximum energy event conceivable. SNL has accumulated nearly 50 years of experience at this site conducting thousands of rocket sled tests. The experience and knowledge gained by analysis of test anomalies are factored into each new test that is planned.

The network of manned roadblocks, barriers, and tower observers who communicate by radio with the launch controller provides a continuous visual watch for unauthorized entry into the hazard area. Tests are only conducted in daylight conditions that permit the verification. The spotters pay particular attention to the direction and altitude of aircraft in the vicinity. If a potential aircraft approach could take place anywhere near the hazard area at launch time, any spotter can instantly stop the countdown by radio.

Test schedules are coordinated with Kirtland Air Force Base (KAFB) during routine monthly meetings. The KAFB command center is called 45 minutes prior to each test and notified of potential hazards to aircraft. The command center relays this warning in coordination with the Federal Aviation Administration (FAA) to all aircraft in the area prior to launch time.

Explosives hazards to the final arming crew are mitigated by a combination of administrative and engineered controls designed to prevent accidental initiation of explosives. The crew size is two people, which allows each person to perform a mutual check and verification of each procedural step. They are highly trained and experienced in explosive ordnance technology and highly knowledgeable about the electrical arming and firing system at the Sled Track Complex. They follow rigorous ES&H SOPs and checklists designed for the specific hazards of the rocket motors and other explosives involved in the tests. The crew cannot approach the

launch site after explosives are installed without having the firing console enable key in their possession. Without this key in the firing console, it is not possible to supply charging voltage to the fireset, and no other source of electrical energy can be connected to the track cabling. Prior to connecting explosives initiators, the crew performs a stray voltage measurement on the connectors before actually inserting them. Both crew members use a checklist procedure to verify that each step is completed.

When the final arming crew returns to the control bunker, a final radio check is performed to ensure all personnel are clear of the hazard area and all air traffic is clear of the test area. If all areas are clear, the launch controller inserts the firing console enable key into the console, and energy is applied to the firing system. The firing sequence is started and the countdown begins.

2.5.10 Abort/Misfire Procedures

2.5.10.1 Hazards

An abort is the deliberate action of interrupting a test countdown due to some event that precludes conducting the test as planned. It could be for a safety reason, such as an approaching aircraft, or it could be for a technical reason, such as a data recording system failure. If the reason for the abort can be corrected in a reasonable amount of time, the test can resume. A misfire is the unexpected failure of the primary test event (rocket firing or explosive detonation). The test countdown may be repeated if the cause of the misfire can be diagnosed (such as failure of the firing system to arm). However, if the reason for the abort or the cause of the misfire cannot be immediately corrected, the test event has to be made safe.

2.5.10.2 Hazard Controls

A wait of 30 minutes is observed before the arming crew enters the hazard area to safe the test event unless it is known that the firing system had not been armed prior to the abort.

The arming crew has the firing console enable key in their possession when they enter the hazard area to safe the test event. The arming crew disconnects the explosive initiators from the firing system. The initiator is shorted and grounded prior to opening the hazard area for correcting the cause of the abort/misfire or the removal of the test assembly from the launch or firing site.

2.5.11 Post-Launch or Post-Firing Procedures, Explosive Ordnance Disposal, Radiation, and Chemical Material Recovery

2.5.11.1 Hazards

During the reentry and recovery process, the SNL Explosives Ordnance Disposal (EOD) and radiation protection team could accidentally detonate explosive debris, or they could become contaminated with radioactive material or toxic chemicals released and scattered from test components. Serious injury or death could result from the rapid deflagration or detonation of residual energetic materials. Serious health problems could be caused by exposure to radioactive and toxic materials.

SNL personnel and KAFB personnel could suffer smoke inhalation and minor burns while fighting a grass fire.

2.5.11.2 Hazard Controls

The reentry and recovery team does not enter the hazard area after a test until all available quick-look information regarding the test has been reviewed. The team is advised about potential residual hazards that would result from a known test anomaly. The team members also carefully review and sign the ES&H SOPs that describe the hazards. They pay particular attention to the portions of the ES&H SOPs that describe recovery hazards that might result from normal, anticipated test results and possible test failure scenarios. The hazard area remains closed to all other personnel until the reentry and recovery team pronounces it safe. If the KAFB EOD team must be called in to dispose of residual explosives hazards, the cordoned area around the explosives remains closed until KAFB pronounces it safe.

If radioactive material is disbursed as a result of the test, the health physics or the SNL EOD crew arranges for cleanup response. If toxic chemicals are disbursed, the SNL EOD crew arranges for cleanup response from waste management personnel. The crews that perform these operations are trained response teams with proper personal protective equipment and tools to safely contain and clean up radioactive and toxic debris.

SNL personnel assisting in grass fire control have received instruction and training from the KAFB Fire Department. The KAFB on-scene fire chief is in command of all Air Force and SNL personnel fighting a grassfire. The fire chief assigns the least hazardous duty to the shovel-equipped SNL personnel, and he enlists their help only if absolutely necessary.

2.5.12 Operational Effects on the Environment

2.5.12.1 Hazards

Environmental consequences associated with operations at the Sled Track Complex include air emissions from rocket motors and explosives; liquid effluent from the water brake section of the tracks; solid waste from test debris; hazardous waste explosives and chemicals; scarring of the ground due to target construction; impact of test items and occasional grass fires; high noise levels from rocket motors and explosives; and sonic booms.

2.5.12.2 Hazard Controls

The types and quantities of explosives and rocket motors are addressed in U.S. Department of Energy (1997). For additional details of rocket motor chemical composition and their exhaust gases, see Chemical Propulsion Information Agency (1994).

Tests that involve less than 4,000 lb of propellant or less than 20 lb of explosives do not require a burn permit. Tests exceeding these limits require a burn permit that is obtained in accordance with Sandia National Laboratories (1999), Section 17B, "Air Permits in Bernalillo County, New Mexico."

The impact area at the south end of the 10,000-ft track is a radioactive material management area (RMMA No. 83) because of depleted uranium contamination of the soil. The south end of the 2,000-ft sled track is also a radioactive material management area (RMMA No. 240). Any material or equipment involved with intrusive work at these sites is surveyed for radioactive contamination before removal.

Test debris may contain hazardous waste. Sled Track Complex personnel have completed all appropriate modules of the hazardous waste training program and separate and containerize the hazardous waste after tests.

Earthen construction is for the purpose of test preparation. It involves areas already disturbed. Construction equipment and personnel are monitored for radiation contamination as required by RMMA control procedures so that radioactive material is not inadvertently buried. Approximately one acre is involved.

Tests are not conducted in wind conditions higher than 25 mph in order to minimize the spread of grass fires.

Energetic test events are capable of generating unacceptable nuisance noise levels in populated areas. These events require a weather watch with the KAFB meteorologist as specified in U.S. Air Force (1996) to ensure that atmospheric sound propagation is favorable.

Table 11-3 summarizes the noise levels at various distances from activities at the Sled Track Complex.

Table 11-3. Noise Levels from Activities at the Sled Track Complex

Source of Noise	Noise Level at the Source	Noise Level at the Ground Hazard Area Boundary	Noise Level at the Western KAFB Boundary
Explosives testing	156 dB	136 dB	114 dB
Collision impacts	145 dB	127 dB	109 dB
First-stage Sprint rocket motors (worst case)	155 dB	137 dB	120 dB
Sonic booms	149 dB	131 dB	114 dB

(U.S. Department of Energy, 1997; West, 1997)

2.6 Accident Analysis Summary

2.6.1 Selection of Accidents Analyzed in Safety Documents

Forty-eight categories of failure events were identified from various accident scenarios developed for sled track operations. Many of these failure events involve energy sources common to several operations or activities.

2.6.2 Analysis Methods and Assumptions

The methodology for the sled track accident analysis is essentially the “binning” methodology of AL 5481.1B, which uses the four hazard severity and probability categories and an additional fifth severity category (II-A, Significant) and a fifth probability category (B-1, Occasional). The additional severity category was defined to include:

- Permanent injuries to people.
- Loss of equipment, of part of the facility, or of test program results.
- Local damage to the DOE site beyond facility boundaries.

The additional probability category was defined to have a nominal frequency between 10^{-4} per year and 10^{-3} per year. (The nominal frequency for Category B in AL 5481.1B was redefined to be between 10^{-3} per year and 10^{-2} per year. See Table 11-4.)

Table 11-4. Accident Likelihood as a Function of Effectiveness Credit

Sum of Credits per Year	Descriptor	Symbol	Nominal Frequency
1-3	Likely	A	$P_e > 10^{-2}$
4-5	Unlikely	B	$10^{-3} < P_e < 10^{-2}$
6-8	Occasional	B-1	$10^{-4} < P_e < 10^{-3}$
9-11	Extremely unlikely	C	$10^{-6} < P_e < 10^{-4}$
12	Incredible	D	$P_e < 10^{-6}$

The technique for estimating the likelihood of occurrence for an event relies on the judgment of sled track staff in evaluating the effectiveness of barriers and controls used as hazard prevention and mitigation measures. The relative effectiveness of hardware versus behavioral controls in achieving risk reduction is established by weighting factors (or “credits”). The credits are assigned as follows:

- **System Design that Minimizes Hazards (5 credits)** - Whenever possible, the design of a system should incorporate features that will either eliminate or otherwise limit the consequences of potential hazards. Design features generally include passive measures (for example, fire-retardant barriers to control the propagation of fires).
- **Multiple Safety Devices (4 credits)** - If a potential hazard cannot be controlled through passive design features, then providing multiple, independent, and reliable safety devices for hazard control is desirable.
- **Single Safety Device (3 credits)** - If only one safety device is available for hazard control, then less credit can be taken for a system with one safety device than for a system that has multiple safety devices.
- **Warning Devices (2 credits)** - Because warning devices only alert human beings that some intervention action is required, less credit can be taken for this hazard control than for one with automatic safety device actuation.
- **Procedures and Training (1 credit)** - Implementation of operating procedures and personnel training will also serve as hazard controls. However, human beings, even when properly trained and operating under effective operating procedures, are still the least reliable element in any system.

As each accident scenario was developed, the hazard controls were evaluated using the effectiveness credits. Credit for a factor was only counted once. For example, an effectiveness credit of 4 was counted for multiple redundant safety devices, or an effectiveness credit of 3 was counted for a single safety device, but both credits were not counted. The sum of the credits (for a maximum of 12) was then related to accident likelihood by the relationships shown in Table 11-4.

The hazard severity categories and the accident likelihood categories were then combined to produce the matrix of risk indices shown Table 11-5.

Table 11-5. Risk Index

Likelihood	Hazard Severity				
	Catastrophic	Critical	Significant	Marginal	Negligible
Likely	I/A	II/A	II-A/A	III/A	IV/A
Unlikely	I/B	II/B	II-A/B	III/B	IV/B
Occasional	I/B-1	II/B-1	II-A/B-1	III/B-1	IV/B-1
Extremely unlikely	I/C	II/C	II-A/C	III/C	IV/C
Incredible	I/D	II/D	II-A/D	III/D	IV/D

Using the DOE Tiger Team process for prioritizing ES&H findings, the four risk groups shown in Table 11-6 were established.

Table 11-6. Risk Groups and Associated Management Actions

Risk Group	Risk Index	Required Management Action
1	<ul style="list-style-type: none"> • I/A • I/B • I/B-1 • II/A • II/B • II/B-1 • II-A/A 	All operations must be stopped. A risk management action plan and a detailed risk analysis must be prepared. A vice president's approval is required before operations may be restarted.
2	<ul style="list-style-type: none"> • I/C • II/C • II-A/B • II-A/B-1 • III/A • III/B 	A director's approval is required to continue this operation. Additional risk assessment may be required. Improvements in preventive or mitigative measures are required.

Table 11-6. Risk Groups and Associated Management Actions (Continued)

Risk Group	Risk Index	Required Management Action
3	<ul style="list-style-type: none"> • I/D • II/D • II-A/C • III/B-1 • IV/A • IV/B 	Acceptable risk with review by the cognizant department manager. Improvement may be necessary.
4	<ul style="list-style-type: none"> • II-A/D • III/C • III/D • IV/B-1 • IV/C • IV/D 	Acceptable risk with routine review by the department manager.

2.6.3 Summary of Accident Analysis Results

Analysts identified no hazards associated with sled track operations in risk group 1. Nineteen hazards were identified in risk group 2, all of which are worker hazards. This group of hazards consists primarily of standard industrial hazards (for example, crane, hoist, and rigging operations; electrical equipment operation; and forklift operation). The “nonstandard industrial hazards” in risk group 2 are associated with explosives and rocket motor storage, assembly, and firing activities. Although the consequences associated with these activities can be catastrophic (severity category I) to workers, the likelihood of such consequences are extremely unlikely (probability category C).

No unacceptable risks to the environment or the offsite public from sled track operations were identified. Onsite environmental hazards from explosives and rocket motor transportation, storage, assembly, arming, and firing activities were either risk group 3 or risk group 4 hazards. These hazards represent significant (category II-A) impacts to the onsite environment, with either extremely unlikely (category C) or incredible (category D) likelihoods of occurrence. The only offsite public hazard (missiles and projectiles) in risk group 3 represents a critical (category II) consequence, with an incredible likelihood of occurrence (category D).

Table 11-7 summarizes these event results.

Table 11-7. Sled Track Complex Event Results

Event	Worker	Onsite Environment	Offsite Public
Explosives transportation	I/D	II-A/D	IV/D
Explosives storage	I/C	II/C	IV/C
Explosives assembly	I/C	II-A/C	NA
Explosives arming	I/C	II-A/D	NA
Explosives firing	I/C	II-A/C	NA
Rocket motor transportation	I/D	II-A/D	IV/D
Rocket motor storage	I/C	III/C	IV/C
Rocket motor assembly	I/C	II-A/C	NA
Rocket motor arming	I/C	II-A/C	NA
Fire set electrocution	I/D	NA	NA
Missiles and projectiles	I/D	IV/D	II/D

(West, 1997)

2.7 Reportable Events

Table 11-8 lists the occurrence reports for the Sled Track Complex over the past five years.

Table 11-8. Occurrence Reports for the Sled Track Complex

Report Number	Title	Category	Description of Occurrence
ALO-KO-SNL-2000-1993-0004	Premature Rocket Sled Detonation, Resulting in Brush Fire	1B and 1G	A detonation on the sled track from a spurious noise in the trigger circuit resulted in a 40-acre brush fire.
ALO-KO-SNL-2000-1994-0001	Water Release at the 10,000-Foot Sled Track in Tech Area III	2E	Potable water was released due to accidental opening of a water valve.
ALO-KO-SNL-NMFAC-1997-0005	Potential Concern Relating to Radiological ER Site Controls Not Followed at 10,000-ft Sled Track	10A	Construction workers dug below an ER site without permission.

2.8 Scenarios for Impact Analysis

In all of the scenarios for impact analysis in this section, base year values are for fiscal year (FY) 1996 unless otherwise noted.

2.8.1 Activity Scenarios

2.8.1.1 Scenario for Test Activities: Rocket Sled Tests

2.8.1.1.1 Alternatives for Test Activities: Rocket Sled Tests

Table 11-9 shows the alternatives for rocket sled tests at the Sled Track Complex.

Table 11-9. Alternatives for Test Activities: Rocket Sled Tests

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
2 tests	10 tests	10 tests	15 tests	80 tests

2.8.1.1.2 Assumptions and Actions for the “Reduced” Values

Impact tests are conducted to certify weapon modifications and shipping container designs. Design engineers and analysts use response data recorded during impact tests to evaluate hardware performance. Test objects are built into expendable sled structures and rocket-accelerated into specific targets at the end of the sled track. Response data are telemetered from test articles to ground station recorders. Impact events are recorded by high-speed framing cameras and flash x-ray.

Reverse ballistic impact tests are used to validate analytical models of a design. Model validation requires more channels of higher response data than certification testing. Target materials are built into expendable sled structures and rocket-accelerated to impact test objects at the end of the track. Response data are recorded directly by hard wire, yielding more channels of higher response data than possible through telemetry. Impact events are again recorded by high-speed framing cameras and flash x-ray.

Parachute tests are conducted to certify parachute performance at design-dynamic pressures. Test objects are rocket-accelerated down the track on recoverable ejector sleds.

Sled velocities and ejection energies are planned to place test objects into precise ballistic trajectories for parachute deployments at the certification dynamic pressures. The sleds are recovered by water brakes that scoop water from a trough in the track. Parachute performance is verified by telemetry, laser tracking, and high-speed framing cameras (see “2.4 Operations and Capabilities,” for additional information on sled testing).

The value for the “reduced” alternative represents the minimum test level required to maintain operational capability. For this to occur, there would have to be a cessation of testing for weapon modifications, Energy and Environment, and Work for Others programs.

2.8.1.1.3 Assumptions and Rationale for the “No Action” Values

Projections under the base year are a representative average of the level of effort of recent history (five years).

The values projected for the FY2003 and FY2008 timeframes under the “no action” alternative were based on a SNL user survey reported in *Results and Conclusions Test Capabilities Task Group* (Bomber *et al.*, 1996). The survey forecasts impact, reverse ballistic, and parachute tests conducted per year for weapon modifications, stockpile evaluations, and Energy and Environment programs. This was a comprehensive, corporate-wide survey of potential users of the complex. The projected increase in activity that the 2008 timeframe shows reflects an increase in weapons research programs.

2.8.1.1.4 Assumptions and Actions for the “Expanded” Values

The historical record of activities from 1987 to 1996 included a peak year of 80 tests. Managers of the complex believe that a reasonable estimate of expanded activities would be bound by this peak number of tests from this historical period.

For this to occur, there would have to be an increase in weapon modifications, Energy and Environment program activities, and Work for Others program activities. In addition, there would have to be multiple weapons research program activities. The UNO 1.3 explosives consumed and expenditures would increase, and additional personnel would be required.

2.8.1.2 Scenario for Test Activities: Explosive Testing

2.8.1.2.1 Alternatives for Test Activities: Explosive Testing

Table 11-10 shows the alternatives for explosive testing at the Sled Track Complex.

Table 11-10. Alternatives for Test Activities: Explosive Testing

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
0 tests	12 tests	12 tests	12 tests	239 tests

2.8.1.2.2 Assumptions and Actions for the “Reduced” Values

Explosive detonations subject test articles to blast waves or propel missiles into test articles. Response data are recorded by hard wire. High-speed framing cameras and flash x-ray record effects.

The value for the “reduced” alternative assumes that no tests will be conducted. Actual testing is not required to maintain capability; however, technical skills and equipment would need to be kept current in order to resume this testing within a reasonable startup time.

2.8.1.2.3 Assumptions and Rationale for the “No Action” Values

No testing took place in 1996; as such, the base year number reflects testing that took place in 1997.

Explosive operations at the south end of the 10,000-ft sled track only became an approved activity in the 1997 timeframe (U.S. Department of Energy, 1997). The occurrence of this test activity is unpredictable and driven by customer demand, and it is referred to as a “walk-in” activity at the complex. Twelve tests were conducted in FY1997.

The values in the FY2003 and FY2008 timeframes assume a continuation of this same level of testing.

2.8.1.2.4 Assumptions and Actions for the “Expanded” Values

The value for the “expanded” alternative is based on a highly conservative upper limit for this activity documented in U.S. Department of Energy (1997). Explosive testing for weapons programs would have to exceed historical levels, consuming approximately 6,075 lb (2,761 kg) of UNO 1.1 explosives. Increases in personnel and expenditures would likely be large.

2.8.1.3 Scenario for Test Activities: Rocket Launcher

2.8.1.3.1 Alternatives for Test Activities: Rocket Launcher

Table 11-11 shows the alternatives for rocket launcher tests at the Sled Track Complex.

Table 11-11. Alternatives for Test Activities: Rocket Launcher

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
0 tests	3 tests	4 tests	4 tests	24 tests

2.8.1.3.2 Assumptions and Actions for the “Reduced” Values

Design engineers and analysts use response data recorded during impact tests to evaluate hardware performance. Test objects are accelerated down a beam on a carriage that is stopped at the end of the beam while the test objects are freed to fly into specific targets at predetermined impact angles and velocities. Two rocket motors are usually used to accelerate the carriage. Explosive devices restrain the carriage until the planned release time. The advantage of this technique over sled track impacts is the ability to achieve oblique impacts. Response data recording by hard wire is possible because of the short accelerating distances. High-speed framing cameras record impact events.

The value for the “reduced” alternative assumes that no tests will be conducted. Actual testing is not required to maintain capability; however, technical skills and equipment would need to be kept current in order to resume this testing within a reasonable startup time. For this to occur, there would have to be a cessation of testing for weapon modifications.

2.8.1.3.3 Assumptions and Rationale for the “No Action” Values

Projections provided for the base year are actuals. The FY2003 and FY2008 projections represent anticipated activity levels based on recent historical levels (last five years) of effort at this facility. It is assumed that four rocket launcher tests per year will be conducted to certify weapon modifications.

2.8.1.3.4 Assumptions and Actions for the “Expanded” Values

Managers of the complex believe that the 24 tests projected under this alternative are a reasonable estimate of the facility's capacity in support of this activity.

Expanded projections assume an increase in testing for weapon modifications and Energy and Environment and weapons research programs. The UNO 1.3 and UNO 1.4 explosives consumed and expenditures would increase, and additional personnel would be required.

2.8.1.4 Scenario for Test Activities: Free-Flight Launch

2.8.1.4.1 Alternatives for Test Activities: Free-Flight Launch

Table 11-12 shows the alternatives for free-flight launch tests at the Sled Track Complex.

Table 11-12. Alternatives for Test Activities: Free-Flight Launch

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
0 tests	40 tests	40 tests	40 tests	150 tests

2.8.1.4.2 Assumptions and Actions for the “Reduced” Values

Free-flight launches are used to certify design functions of small test objects such as submunitions. Test objects are launched by rocket into free flight from portable launch rails. This technique uses a single rocket motor and fewer personnel, and it costs less than sled tests; thus, it is an efficient method for testing small packages. A number of free-flight tests can be conducted per day, while sled tests usually take two days per test. Telemetry, laser tracking, and high-speed framing cameras verify functions.

The value for the “reduced” alternative assumes that no tests will be conducted. Actual testing is not required to maintain capability; however, technical skills and equipment would need to be kept current in order to resume this testing within a reasonable startup time. For this to occur, there would have to be a cessation of testing for Work for Others programs.

2.8.1.4.3 Assumptions and Rationale for the “No Action” Values

Projections under the base year are a representative average of the level of effort of recent history (five years).

The values projected for the FY2003 and FY2008 timeframes were based on a SNL user survey reported in *Results and Conclusions Test Capabilities Task Group* (Bomber *et al.*, 1996). This was a comprehensive, corporate-wide survey of potential users of the complex. The survey forecasts an expenditure level in Work for Others programs for the complex. This is the principal Work for Others program at the complex. The assumed values (40 tests) are the number of tests this expenditure would support.

2.8.1.4.4 Assumptions and Actions for the “Expanded” Values

The historical record of activities (five years) included a peak year of 128 tests. Managers of the complex believe that 150 tests would be a reasonable upper bound for the “expanded” alternative. The UNO 1.3 explosives consumed and overall expenditures would increase, and additional personnel would be required.

2.8.2 Material Inventories

2.8.2.1 Nuclear Material Inventory Scenario for Depleted Uranium

2.8.2.1.1 Alternatives for Depleted Uranium Nuclear Material Inventory

Table 11-13 shows the alternatives for the depleted uranium nuclear material inventory at the Sled Track Complex.

Table 11-13. Alternatives for Depleted Uranium Nuclear Material Inventory

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
0 kg	0 kg	0 kg	0 kg	0 kg

2.8.2.1.2 Operations That Require Depleted Uranium

There are no operations at the complex that require depleted uranium or any other nuclear material. However, nuclear material may be included in objects being tested to authenticate certification of a system. As such, they do not contribute to the operation but are subjected to it.

Ownership of the materials being tested does not transfer to the management of the complex. The materials are maintained under SNL/NM security. These materials are kept in safe-secure facilities for a period of one to a few days. The inventory function is maintained by the security organization and accountability remains with the test request organization. As such, there is never an administrative inventory of these materials at the complex.

2.8.2.1.3 Basis for Projecting the “Reduced” and “Expanded” Values

This section is not applicable.

2.8.2.2 Radioactive Material Inventory Scenarios

The Sled Track Complex has no radioactive material inventories.

2.8.2.3 Sealed Source Inventory Scenarios

The Sled Track Complex has no sealed source inventories.

2.8.2.4 Spent Fuel Inventory Scenarios

The Sled Track Complex has no spent fuel inventories.

2.8.2.5 Chemical Inventory Scenarios

The Sled Track Complex has no inventories of chemicals of concern.

2.8.2.6 Explosives Inventory Scenarios

2.8.2.6.1 Explosives Inventory Scenario for Bare UNO 1.1

Alternatives for Bare UNO 1.1 Explosives Inventory - Table 11-14 shows the alternatives for the bare UNO 1.1 explosives inventory at the Sled Track Complex.

Table 11-14. Alternatives for Bare UNO 1.1 Explosives Inventory

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
0 g	0 g	0 g	0 g	0 g

Operations That Require Bare UNO 1.1 - Explosive inventory is managed through the SNL Explosive Inventory System. Explosives are delivered to the Sled Track Complex on a just-in-time basis. While they are at the complex, explosives are accounted for within the SNL Explosive Inventory System until they are consumed. Explosives not consumed during testing are returned to the storage complex.

Basis for Projecting the “Reduced” and “Expanded” Values - This section is not applicable.

2.8.2.6.2 Explosives Inventory Scenario for Bare UNO 1.3

Alternatives for Bare UNO 1.3 Explosives Inventory - Table 11-15 shows the alternatives for the bare UNO 1.3 inventory at the Sled Track Complex.

Table 11-15. Alternatives for Bare UNO 1.3 Explosives Inventory

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
0 g	0 g	0 g	0 g	0 g

Operations That Require Bare UNO 1.3 - Explosive inventory is managed through the SNL Explosive Inventory System. Explosives are delivered to the Sled Track Complex on a just-in-time basis. While they are at the complex they are accounted for within the SNL Explosive Inventory System until they are consumed. Explosives not consumed during testing are returned to the storage complex.

Basis for Projecting the “Reduced” and “Expanded” Values - This section is not applicable.

2.8.2.6.3 Explosives Inventory Scenario for Bare UNO 1.4

Alternatives for Bare UNO 1.4 Explosives Inventory - Table 11-16 shows the alternatives for bare UNO 1.4 explosives inventory at the Sled Track Complex.

Table 11-16. Alternatives for Bare UNO 1.4 Explosives Inventory

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
0 g	0 g	0 g	0 g	0 g

Operations That Require Bare UNO 1.4 - Explosive inventory is managed through the SNL Explosive Inventory System. Explosives are delivered to the Sled Track Complex on a just-in-time basis. While they are at the complex they are accounted for within the SNL Explosive Inventory System until they are consumed. Explosives not consumed during testing are returned to the storage complex.

Basis for Projecting the “Reduced” and “Expanded” Values - This section is not applicable.

2.8.2.7 Other Hazardous Material Inventory Scenarios

The Sled Track Complex has no inventories of hazardous materials that do not fall into the categories of nuclear or radioactive material, sealed sources, spent fuel, explosives, or chemicals.

2.8.3 Material Consumption

2.8.3.1 Nuclear Material Consumption Scenario for Depleted Uranium

2.8.3.1.1 Alternatives for Depleted Uranium Consumption

Table 11-17 shows the alternatives for depleted uranium consumption at the Sled Track Complex.

Table 11-17. Alternatives for Depleted Uranium Consumption

Reduced Alternative		No Action Alternative						Expanded Alternative	
		Base Year		FY2003		FY2008			
0 pkgs	0 kg	0 pkgs	0 kg	0 pkgs	0 kg	0 pkgs	0 kg	0 pkgs	0 kg

2.8.3.1.2 Operations That Require Depleted Uranium

No operation at the Sled Track Complex requires depleted uranium or any other nuclear material. Nuclear materials are included within objects being tested to authenticate certification of systems. Thus, the nuclear material is subjected to testing at the complex.

Nuclear material subjected to testing is recovered after tests and returned to the test requester. See “2.8.2.1 Nuclear Material Inventory Scenario for Depleted Uranium.”

2.8.3.1.3 Basis for Projecting the “Reduced” and “Expanded” Values

This section is not applicable.

2.8.3.2 Radioactive Material Consumption Scenarios

Radioactive material is not consumed at the Sled Track Complex.

2.8.3.3 Chemical Consumption Scenarios

Information initially provided for this section resides in the Facility Information Manager database and will be made available to the analysts responsible for preparing the sitewide environmental impact statement.

2.8.3.4 Explosives Consumption Scenarios**2.8.3.4.1 Explosives Consumption Scenario for Bare UNO 1.4 Explosives**

Alternatives for Bare UNO 1.4 Explosives Consumption - Table 11-18 shows the alternatives for bare UNO 1.4 explosives consumption at the Sled Track Complex.

Table 11-18. Alternatives for Bare UNO 1.4 Explosives Consumption

Reduced Alternative		No Action Alternative						Expanded Alternative	
		Base Year		FY2003		FY2008			
0 pkgs	0 g	3 pkgs	27 g	4 pkgs	36 g	4 pkgs	36 g	24 pkgs	214 g

Operations That Require Bare UNO 1.4 Explosives - Rocket launcher testing requires UNO 1.4 explosives. A separation device with an explosive power cartridge restrains the carriage on the beam until the rockets are ignited.

Basis for Projecting the “Reduced” and “Expanded” Values - The projections for the “reduced” and “expanded” alternatives are linear projections of test levels. One power cartridge with 8.9 g of UNO 1.4 explosives is used per test.

2.8.3.4.2 Explosives Consumption Scenario for Bare UNO 1.3 Explosives

Alternatives for Bare UNO 1.3 Explosives Consumption - Table 11-19 shows the alternatives for bare UNO 1.3 explosives consumption at the Sled Track Complex.

Table 11-19. Alternatives for Bare UNO 1.3 Explosives Consumption

Reduced Alternative		No Action Alternative						Expanded Alternative	
		Base Year		FY2003		FY2008			
40 pkgs	480 kg	246 pkgs	3,354 kg	248 pkgs	3,382 kg	348 pkgs	4,745 kg	1,588 pkgs	36,170 kg

Operations That Require Bare UNO 1.3 Explosives - Rocket sled, rocket launcher, and free-flight tests require UNO 1.3 explosives; however, not all tests require explosives in the same proportion. Sled tests require, on the average, 20 rocket motors per test. Rocket launcher tests require one to two rocket motors, and free-flight tests require one rocket motor.

Basis for Projecting the “Reduced” and “Expanded” Values - The value for the “reduced” alternative includes the 40 HVAR rocket motors required for the two sled tests listed in “2.8.1 Activity Scenarios.”

Table 11-20 shows the breakdown of rocket motors required for the expanded value.

Table 11-20. Rocket Motors Required for the Expanded Alternative

Tests	Packages	Kg
80 Rocket Sled Tests		
4 tests with one first-stage Sprint	4	7,200
6 tests with one second-stage Sprint	6	2,700
10 tests with three Nikes	30	4,100
10 tests with ten Super Zunis	100	2,000
20 tests with 25 Zunis	500	8,200
30 Tests with 25 HVARs	750	9,000

Table 11-20. Rocket Motors Required for the Expanded Alternative (Continued)

Tests	Packages	Kg
24 Rocket Launcher Tests		
4 tests with two Zunis	8	130
20 tests with two HVARs	40	480
150 Free-Flight Tests		
30 tests with one HVAR	30	360
120 tests with one Zuni	120	2,000
Totals	1,588	36,170

These are the quantities estimated to conduct the tests for the “expanded” alternative values of “2.8.1 Activity Scenarios.” They are based on past history, but there is no way of determining how many or what types of tests will be required in the future.

2.8.3.4.3 Explosives Consumption Scenario for Bare UNO 1.1 Explosives

Alternatives for Bare UNO 1.1 Explosives Consumption - Table 11-21 shows the alternatives for bare UNO 1.1 explosives consumption at the Sled Track Complex.

Table 11-21. Alternatives for Bare UNO 1.1 Explosives Consumption

Reduced Alternative		No Action Alternative						Expanded Alternative	
		Base Year		FY2003		FY2008			
0 pkgs	0 kg	0 pkgs	0 kg	12 pkgs	400 kg	12 pkgs	400 kg	239 pkgs	2,761 kg

Operations That Require Bare UNO 1.1 Explosives - Explosive tests require UNO 1.1 explosives to subject test objects to blast waves or propel missiles into test objects.

Basis for Projecting the “Reduced” and “Expanded” Values - No UNO 1.1 explosives will be required for the “reduced” alternative. The UNO 1.1 explosives of the “expanded” alternative assumes the explosive tests projected in “2.8.1 Activity Scenarios,” which are, as stated, a historical level.

2.8.4 Waste

2.8.4.1 Low-Level Radioactive Waste Scenario

Low-level radioactive waste is not produced at the Sled Track Complex.

2.8.4.2 Transuranic Waste Scenario

Transuranic waste is not produced at the Sled Track Complex.

2.8.4.3 Mixed Waste

2.8.4.3.1 Low-Level Mixed Waste Scenario

Alternatives for Low-Level Mixed Waste at the Sled Track Complex - Table 11-22 shows the alternatives for low-level mixed waste at the Sled Track Complex.

Table 11-22. Alternatives for Low-Level Mixed Waste

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
0 kg	0 kg	0 kg	0 kg	0 kg

Operations That Generate Low-Level Mixed Waste - No low-level mixed waste is produced from normal operations. While tests are designed to preclude releases of radioactive and hazardous materials under normal operations, material from test assemblies could be accidentally released to the ground following impacts or explosions. In this event, cleanup of the area would produce some low-level mixed radioactive waste. Quantitative estimates are not available. See "2.5 Hazards and Hazard Controls," for list of materials at issue.

General Nature of Waste - See Section 2.5, "Hazards and Hazard Controls," for a description of radioactive material that could accidentally contribute to residuals on the ground.

Waste Reduction Measures - No waste reduction measures exist.

Basis for Projecting the "Reduced" and "Expanded" Values - The projections for the "reduced" and "expanded" values are based on program knowledge.

2.8.4.3.2 Transuranic Mixed Waste Scenario

Transuranic mixed waste is not produced at the Sled Track Complex.

2.8.4.4 Hazardous Waste Scenario

2.8.4.4.1 Alternatives for Hazardous Waste at the Sled Track Complex

Table 11-23 shows the alternatives for hazardous waste at the Sled Track Complex.

Table 11-23. Alternatives for Hazardous Waste

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
3 kg	15 kg	15 kg	15 kg	50 kg

2.8.4.4.2 Operations That Generate Hazardous Waste

Operations that generate hazardous waste include assembly of test packages involving machining operations that generate residues, bonding of parts with epoxies, cleaning of parts, and wiping of excess materials.

2.8.4.4.3 General Nature of Waste

Waste includes rags, protective clothing and containers, and metal turnings from the machine shop. See "2.5 Hazards and Hazard Controls," for descriptions of hazardous material in the waste.

2.8.4.4.4 Waste Reduction Measures

No additional waste reduction measures are in effect beyond those directed by SNL/NM Division 6000 procedures.

2.8.4.4.5 Basis for Projecting the "Reduced" and "Expanded" Values

Waste projections for the reduced and expanded alternatives are based on historical engineering experience for the activity levels projected in "2.8.1 Activity Scenarios"; waste generation is not linear.

2.8.5 Emissions

2.8.5.1 Radioactive Air Emissions Scenarios

Radioactive air emissions are not produced at the Sled Track Complex.

2.8.5.2 Chemical Air Emissions

Information on an extensive list of chemicals was obtained from the SNL/NM Chemical Inventory System (CIS). For the air emissions analysis, the entire annual inventory of these chemicals was assumed to have been released over a year of operations for each specific

facility (i.e., the annual inventory was divided by facility operating hours). The emissions from this release were then subjected, on a chemical-by-chemical basis, to a progressive series of screening steps for potential exceedances of both regulatory and human health thresholds. For those chemicals found to exceed this screening, process knowledge was used to derive emission factors. The emission factors for these chemicals were then modeled using the U.S. Environmental Protection Agency's *Industrial Source Complex Air Quality Dispersion Model, Version 3*. The results of this modeling are discussed as part of the analysis in support of the SNL/NM site-wide environmental impact statement.

2.8.5.3 Open Burning Scenarios

2.8.5.3.1 Open Burning Scenario for Explosives

Alternatives for Explosives Open Burning at the Sled Track Complex - Table 11-24 shows the alternatives for open burning at the Sled Track Complex.

Table 11-24. Alternatives for Explosives Open Burning

Reduced Alternative		No Action Alternative						Expanded Alternative	
		Base Year		FY2003		FY2008			
0 burns	0 kg	0 burns	0 kg	12 burns	400 kg	12 burns	400 kg	79 burns	1,670 kg

Description of Explosives Open Burning Operations - The detonation of explosive charges of over 20 lb (9 kg) requires an open burn permit.

Basis for Projecting the “Reduced” and “Expanded” Values - Projections for the “reduced” and “expanded” alternatives are linear projections of test levels. Activity did not exist in the base year.

2.8.5.4 Process Wastewater Effluent Scenario

The Sled Track Complex does not generate process wastewater.

2.8.6 Resource Consumption

2.8.6.1 Process Water Consumption Scenario

The Sled Track Complex does not consume process water.

2.8.6.2 Process Electricity Consumption Scenario

The Sled Track Complex does not consume process electricity.

2.8.6.3 Boiler Energy Consumption Scenario

The Sled Track Complex does not consume energy for boilers.

2.8.6.4 Facility Personnel Scenario

2.8.6.4.1 Alternatives for Facility Staffing at the Sled Track Complex

Table 11-25 shows the alternatives for facility staffing at the Sled Track Complex.

Table 11-25. Alternatives for Facility Staffing

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
8 FTEs	8 FTEs	8 FTEs	8 FTEs	40 FTEs

2.8.6.4.2 Operations That Require Facility Personnel

Sled, rocket launcher, free-flight launch, and explosive tests require facility personnel.

Table 11-26 shows the breakdown of FTEs for the “no action” and “reduced” alternatives.

Table 11-26. FTEs for the No Action and Reduced Alternatives

Tests	SNL Staff			Contractors
	Engineer	Technicians	Administrative	
Sled testing	0.6	1	0.4	1.4
Rocket launcher testing	0.2	0.4	0.1	0.3
Free-flight testing	0.3	0.5	0.2	0.5
Explosive testing	0.4	0.6	0.3	0.8
Totals	1.5	2.5	1	3

FTE costs in FY1998 dollars are \$1.2 million.

2.8.6.4.3 Staffing Reduction Measures

No staffing reduction measures exist.

2.8.6.4.4 Basis for Projecting the “Reduced” and “Expanded” Values

The value for the “reduced” alternative is the amount of personnel required to maintain the viability of the activities at the Sled Track Complex. The breakdown is the same as that of the “no action” alternative.

Table 11-27 shows the breakdown of FTEs for the “expanded” alternative.

Table 11-27. FTEs for the Expanded Alternative

Tests	SNL Staff			Contractors
	Engineer	Technicians	Administrative	
Sled testing	2.5	4.2	1.3	5
Rocket launcher testing	0.6	1.2	0.2	1
Free-flight testing	0.9	1.5	0.6	2
Explosive testing	3	4.6	1.4	10
Totals	7	11.5	3.5	18

FTE costs in FY1998 dollars are \$5.5 million.

2.8.6.5 Expenditures Scenario

2.8.6.5.1 Alternatives for Expenditures at the Sled Track Complex

Table 11-28 shows the alternatives for expenditures at the Sled Track Complex.

Table 11-28. Alternatives for Expenditures

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
\$190,000	\$334,000	\$376,000	\$451,000	\$1,951,000

2.8.6.5.2 Operations That Require Expenditures

Operations that require expenditures include sled, rocket launcher, free-flight and explosive tests. The major expenditure categories are rocket sleds, targets, explosives, electrical and mechanical equipment, tools, and contract maintenance.

2.8.6.5.3 Expenditure Reduction Measures

No expenditure reduction measures exist.

2.8.6.5.4 Basis for Projecting the “Reduced” and “Expanded” Values

The expenditures for the “reduced” alternative are the minimum to maintain the viability of the Sled Track Complex. Table 11-29 shows the breakdown of expenditures for the “reduced” alternative.

Table 11-29. Expenditures for the Reduced Alternative

Activities	Expenditures
Sled testing	\$150,000
Rocket launcher testing	\$20,000
Free-flight testing	\$0
Explosive testing	\$20,000
Total	\$190,000

Sled testing expenditures include the conducting of two tests. (See “2.8.1 Activity Scenarios.”) Table 11-30 shows the breakdown of expenditures for the “expanded” alternative.

Table 11-30. Expenditures for the Expanded Alternative

Activities	Expenditures
Sled testing	\$800,000
Rocket launcher testing	\$120,000
Free-flight testing	\$75,000
Explosive testing	\$956,000
Total	\$1,951,000

3.0 CENTRIFUGE COMPLEX SOURCE INFORMATION

3.1 Purpose and Need

The Centrifuge Complex is the SNL test facility for acceleration testing of large tests objects such as weapon systems, satellite systems, reentry vehicles, and rocket motors. It is also used by SNL Energy and Environment programs to certify designs in transportation technology.

The DOE needs the Centrifuge Complex to support research and development activities in the national interest on an as-available basis.

(Bomber *et al.*, 1996; U.S. Department of Energy, 1997)

3.2 Description

The Centrifuge Complex has two centrifuge units:

- The 29-ft indoor centrifuge, located inside Building 6526
- The 35-ft outdoor centrifuge, which is adjacent to Building 6526

The 29-ft centrifuge can subject test objects weighing up to 16,000 pounds to an acceleration of 100 times the acceleration of gravity (100 G). An acceleration of 300 G can be achieved with lighter test objects.

The centrifuge is located in a belowground, 80-ft diameter pit and is completely enclosed in Building 6526. There is a light lab for test preparations and a control room located in the building.

The 35-ft centrifuge can subject test objects weighing up to 10,000 pounds to an acceleration of 45 G. An acceleration of 240 G can be achieved with lighter test objects. It is located within a reinforced concrete wall backed by an earthen barrier. The top is open; thus, the centrifuge is “outdoors.”

Both centrifuges are hydraulically driven by motors located in their bases. The hydraulic fluid to drive the motors circulates from pumps in Building 6523B through a closed system of underground pipes. The maximum allowable working pressure for the system is 5,000 psi. Approximately 3,000 gal of hydraulic fluid is required to operate the system. The overall fluid capacity including the reservoir is 5,000 gal.

The complex is fenced and contains an additional building, Building 6523, which is used as an office for the complex staff and headquarters for the test labor support contractor personnel that supplement the technical staff of the Albuquerque Full-Scale Experimental Complex Department.

(U.S. Department of Energy, 1997)

3.3 Program Activities

Table 11-31 shows the program activities at the Centrifuge Complex.

Table 11-31. Program Activities at the Centrifuge Complex

Program Name	Activities at the Centrifuge Complex	Category of Program	Related Section of the SNL Institutional Plan
Performance Assessment Science and Technology	Provide environmental, safety, and survivability testing for nuclear weapon applications.	Programs for the Department of Energy	Section 6.1.1.1
Sustaining Critical Progress in Model Validation	Subject tests objects to continuous acceleration.	Major Programmatic Initiatives	Section 7.1.3
All Other Reimbursables	Acceleration testing of weapon and satellite systems.	Work for Non-DOE Entities (Work for Others)	Section 6.2.8
Energy Programs	Impact testing to certify designs in transportation systems.	Major Programmatic Initiatives	Section 7.2.1

3.4 Operations and Capabilities

The Centrifuge Complex is used to subject test objects to continuous acceleration. Test objects are attached to one end of a boom that rotates around a central shaft. Counterweights are attached to the other end of the boom to counterbalance the test objects. Hydraulic drive motors rotate the central shaft and boom to achieve the test acceleration.

The hydraulic fluid that powers the motors is supplied from six variable-displacement pumps located in Building 6523B. The hydraulic fluid circulates between the pumps and motors through a closed loop of underground pipes. Varying the displacement of the pumps controls the rate of rotation. The pumps are used to power both centrifuges.

Data are transmitted to recorders through slip rings or telemetered to recording stations. Test events are recorded on video or by motion photography.

The 29-ft indoor centrifuge subjects test packages that weigh up to 16,000 lb to acceleration forces of up to 100 G and subjects lighter packages to acceleration forces of up to 300 G. Typical payloads are weapons systems, satellite systems, reentry vehicles, geotechnic loads, rocket components, and sensing devices.

Combined vibration and acceleration testing can be achieved by mounting an electrodynamic shaker on the arm of the 29-ft centrifuge. Items weighing up to 56 lb can be vibrated while under 50 G of acceleration.

The 35-ft outdoor centrifuge subjects objects that weigh up to 10,000 lb to acceleration forces of up to 240 G. The outdoor centrifuge is used for large objects or objects with hazardous payloads, such as those that are intentionally released to study collision impacts against hard surfaces.

The piping system for the hydraulic system has exhibited small leaks. The hydraulic fluid is nontoxic and does not pose a hazard to persons. A maintenance project is currently underway to replace the piping.

(U.S. Department of Energy, 1997)

3.5 Hazards and Hazard Controls

Hazards at the Centrifuge Complex include the following:

- Noise from centrifuge operation, collision impacts, and explosive testing
- Small amounts of airborne emissions, including carbon monoxide and lead, from explosives testing
- Fragments from explosives testing

Table 11-32 summarizes the noise levels at various distances from activities at the Centrifuge Complex.

Table 11-32. Noise Levels From Activities at the Centrifuge Complex

Source of Noise	Noise Level at the Source	Noise Level at the Ground Hazard Area Boundary	Noise Level at the Western KAFB Boundary
Explosives testing	140 dB	126 dB	93 dB
Collision tests	117 dB	105 dB	78 dB
Motors	86 dB	64 dB	37 dB

Hazard controls at the Centrifuge Complex include:

- Ground hazard areas, which are delineated zones around test sites that restrict personnel from potentially hazardous operations and reduce the potential exposure of personnel to noise, air emissions, metal fragments, and other potentially hazardous conditions. The ground hazard areas are demarcated and enforced by means of warning lights and signs,

spotters, fences, barricades, and gates. Table 11-33 shows the ground hazard areas for outdoor test activities at the Centrifuge Complex.

- The hearing conservation program, which includes SNL/NM standards to protect personnel from hearing damage.
- Weather watch program to determine favorable atmospheric condition for testing, minimize sound propagation, and manage air pollutant dispersal.
- ES&H SOPs.
- Waste handling procedures.
- Removal of dispersed materials.

Table 11-33. Ground Hazard Areas for Outdoor Testing Activities at the Centrifuge Complex

Activities	Ground Hazard Areas
Centrifuge testing at less than 80 rpm	328 ft
Centrifuge testing at greater than 80 rpm	656 ft
Testing of less than 1.5 lb of explosives	656 ft

3.5.1 Chemical Materials

3.5.1.1 Hazards

Small amounts of chemicals are used in test preparations. For example, various adhesives and epoxies are used to fasten transducers and similar items.

Cleaners, lubricants, solvents, paints, and agents that might be used in small quantities include the following:

- Acetone
- Alcohol isopropyl
- Contact cement
- Ethanol
- Acrylic cement
- Braze flux
- Dow Corning RTV adhesive
- Krylon contact cleaner

- Molykote grease
- Zinc chromate
- Silicone rubber

Compressed gases in the assembly areas include the following:

- Acetylene and oxygen for welding
- Argon
- Helium

3.5.1.2 Hazard Controls

Chemical usage is small. Chemicals are in 1-gal containers or less. Standard procedures outlined in Sandia National Laboratories (1999) dictate that the amount of chemicals present in the assembly areas at any one time be limited to the minimum amount needed for the performance of the work. All chemicals are stored in approved chemical storage cabinets when not being used.

Compressed gases are stored in DOT-approved compressed gas cylinders. They are used in accordance with Shrouf (1995).

3.5.2 Nuclear and Radioactive Materials

3.5.2.1 Hazards

Nuclear and radioactive materials associated with testing at the Centrifuge Complex include special nuclear material, depleted uranium, uranium alloys, thorium alloys and compounds, and tritium. These materials are always contained in sealed, weaponized assemblies when delivered to the Centrifuge Complex. The assemblies are not opened during their presence at the complex. The most common radioactive material utilized is depleted uranium, which has a very low specific activity (1.0 $\mu\text{Ci/g}$). A typical weapon assembly may contain depleted uranium that produces gamma radiation at the case surface of up to 1 mrem per hour. However, personnel have relatively short exposures to these assemblies during integration and test. Annual radiation exposure to personnel is not expected to exceed 100 mrem per year. On this basis, facility personnel are not required to wear film badges such as the thermoluminescent dosimeter. All radiation exposures conform to the requirements of 10 CFR 835, *Occupational*

Radiation Protection, and DOE 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees*.

3.5.2.2 Hazard Controls

Either the Explosives Storage Team or the Nuclear/General Material Storage Team delivers assemblies with radioactive materials to the Centrifuge Complex. The former team must provide transportation and handling if explosives are included in the test unit. These assemblies are checked for radioactive surface contamination by trained health physics personnel who conduct swipe tests of the shipping container, if used, and the test unit. In addition, these personnel measure the average magnitude of gamma emission from the test unit at the surface and at a nominal distance of one meter.

To ensure nuclear safety, all test units with accountable quantities of nuclear material are also carefully measured by gamma spectroscopy and neutron fluence to verify the exact identity of nuclear material. These measurements are performed by trained personnel from the Material Systems and Security Audits Department. This service is automatically triggered by the movement action of accountable nuclear material. The nuclear verification is performed immediately after receipt of the test unit at the Centrifuge Complex.

(U.S. Department of Energy, 1997)

3.6 Accident Analysis Summary

The Centrifuge Complex has been found to be a low-hazard nonnuclear facility by the SNL primary hazard screening process and does not require a safety analysis report. A follow-up hazards analysis is planned but is not expected to change the earlier finding (Kolb, 1997).

3.7 Reportable Events

Table 11-34 lists the only occurrence report for the Centrifuge Complex over the past five years.

Table 11-34. Occurrence Report for the Centrifuge Complex

Report Number	Title	Category	Description of Occurrence
ALO-KO-SNL-2000-1994-0002	Hydraulic Oil Spill Over 100 Gallons	2B	An oil spill occurred when a hydraulic pump failed during a centrifuge test.

3.8 Scenarios for Impact Analysis

In all of the scenarios for impact analysis in this section, base year values are for FY1996 unless otherwise noted.

3.8.1 Activity Scenarios

3.8.1.1 Scenario for Test Activities: Centrifuge

3.8.1.1.1 Alternatives for Test Activities: Centrifuge

Table 11-35 shows the alternatives for centrifuge tests at the Centrifuge Complex.

Table 11-35. Alternatives for Test Activities: Centrifuge

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
2 tests	32 tests	46 tests	46 tests	120 tests

3.8.1.1.2 Assumptions and Actions for the “Reduced” Values

A test is one operation of the centrifuge that subjects a test object to a specified acceleration amplitude and duration. The changes over time are for additional certification of joint test assemblies.

The value for the “reduced” alternative represents the minimum level of testing required to maintain operational capability. For this to occur, there would have to be a cessation of testing for certification of weapon modifications, joint test assemblies, and Work for Others programs.

3.8.1.1.3 Assumptions and Rationale for the “No Action” Values

Projections under the base year are actuals.

The values projected for the FY2003 and FY2008 timeframes are based on a SNL user survey reported in *Results and Conclusions Test Capabilities Task Group* (Bomber *et al.*, 1996). This was a comprehensive, corporate-wide survey of potential users of the complex. The projected increases in activity forecasts acceleration testing for certification of joint test assemblies, weapon modifications, and Work for Others programs.

3.8.1.1.4 Assumptions and Actions for the “Expanded” Values

The historical record of activities from 1987 to 1996 included a peak year of 120 tests. Managers of the complex believe that a reasonable estimate of expanded activities would be bound by this peak number of tests (120) from this historical period. For this to occur, there would have to be an increase in weapon modifications and Energy and Environment and Work for Others program activities. In addition, there would have to be multiple weapons research program activities.

3.8.1.2 Scenario for Test Activities: Impact

3.8.1.2.1 Alternatives for Test Activities: Impact

Table 11-36 shows the alternatives for impact tests at the Centrifuge Complex.

Table 11-36. Alternatives for Test Activities: Impact

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
0 tests	0 tests	10 tests	10 tests	100 tests

3.8.1.2.2 Assumptions and Actions for the “Reduced” Values

Small test objects are released from the arm of the 35-ft centrifuge on tangential trajectories to impact targets. These tests certify nuclear material shipping container designs for Energy and Environment programs.

The value for the “reduced” alternative assumes that there will be no impact tests conducted. Actual testing is not required to maintain capability; however, technical skills and equipment would need to be kept current in order to resume this testing within a reasonable startup time. For this to occur, there would have to be a cessation of testing for certification of nuclear material shipping containers at this complex.

3.8.1.2.3 Assumptions and Rationale for the “No Action” Values

No impact testing took place in 1996.

The values for the FY2003 and FY2008 timeframes assume that ten impact tests will be conducted per year. This projection is based on the historical experience and engineering judgment of operations personnel.

3.8.1.2.4 Assumptions and Actions for the “Expanded” Values

Managers of the complex believe that a reasonable estimate of expanded activities would be bound by a peak year number of 100 tests.

3.8.2 Material Inventories

3.8.2.1 Nuclear Material Inventory Scenario for Depleted Uranium

3.8.2.1.1 Alternatives for Depleted Uranium Nuclear Material Inventory

Table 11-37 shows the alternatives for depleted uranium inventory at the Centrifuge Complex.

Table 11-37. Alternatives for Depleted Uranium Nuclear Material Inventory

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
0 kg	0 kg	0 kg	0 kg	0 kg

3.8.2.1.2 Operations That Require Depleted Uranium

There are no operations at the complex that require depleted uranium or any other nuclear material. However, nuclear material may be included in test objects to authenticate certification of a system. As such, they do not contribute to the operation but are subjected to it.

Ownership of the material being tested does not transfer to the management of the complex, but the material is maintained under SNL/NM security. These materials are kept in safe-secure facilities for a period of one to a few days. The inventory function is maintained by the security organization, and accountability remains with the test request organization. As such, there is never an administrative inventory of these materials at the complex.

3.8.2.1.3 Basis for Projecting the “Reduced” and “Expanded” Values

This section is not applicable.

3.8.2.2 Radioactive Material Inventory Scenarios

The Centrifuge Complex has no radioactive material inventories.

3.8.2.3 Sealed Source Inventory Scenarios

The Centrifuge Complex has no sealed source inventories.

3.8.2.4 Spent Fuel Inventory Scenarios

The Centrifuge Complex has no spent fuel inventories.

3.8.2.5 Chemical Inventory Scenarios

The Centrifuge Complex has no inventories of chemicals of concern.

3.8.2.6 Explosives Inventory Scenario for Bare UNO 1.1

3.8.2.6.1 Alternatives for Bare UNO 1.1 Explosives Inventory

Table 11-38 shows the alternatives for the bare UNO 1.1 explosives inventory at the Centrifuge Complex.

Table 11-38. Alternatives for Bare UNO 1.1 Explosives Inventory

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
0 kg	0 kg	0 kg	0 kg	0 kg

3.8.2.6.2 Operations That Require Bare UNO 1.1

Explosive inventory is managed through the SNL Explosive Inventory System. Explosives are delivered to the Centrifuge Complex on a just-in-time basis. While at the complex, the material is accounted for within the SNL Explosive Inventory System until it is consumed. Explosives not consumed during testing are returned to the storage complex.

3.8.2.6.3 Basis for Projecting the “Reduced” and “Expanded” Values

This section is not applicable.

3.8.2.7 Other Hazardous Material Inventory Scenarios

The Centrifuge Complex has no inventories of hazardous materials that do not fall into the categories of nuclear or radioactive material, sealed sources, spent fuel, explosives, or chemicals.

3.8.3 Material Consumption

3.8.3.1 Nuclear Material Consumption Scenario for Depleted Uranium

3.8.3.1.1 Alternatives for Depleted Uranium Consumption

Table 11-39 shows the alternatives for depleted uranium consumption at the Centrifuge Complex.

Table 11-39. Alternatives for Depleted Uranium

Reduced Alternative		No Action Alternative						Expanded Alternative	
		Base Year		FY2003		FY2008			
0 pkgs	0 kg	0 pkgs	0 kg	0 pkgs	0 kg	0 pkgs	0 kg	0 pkgs	0 kg

3.8.3.1.2 Operations That Require Depleted Uranium

No operation at the Centrifuge Complex requires depleted uranium or any other nuclear material. Nuclear material is included within objects being tested to authenticate certification of systems. Thus, the nuclear material is subjected to testing at the complex.

Nuclear material subjected to testing is always contained in sealed, weaponized assemblies that are not opened during their presence at the complex and that are returned to the test requester as they were received.

3.8.3.1.3 Basis for Projecting the “Reduced” and “Expanded” Values

This section is not applicable.

3.8.3.2 Radioactive Material Consumption Scenarios

Radioactive material is not consumed at the Centrifuge Complex.

3.8.3.3 Chemical Consumption Scenarios

Information initially provided for this section resides in the Facility Information Manager database and will be made available to the analysts responsible for preparing the sitewide environmental impact statement.

3.8.3.4 Explosives Consumption Scenarios

3.8.3.4.1 Explosives Consumption Scenario for Bare UNO 1.3 Explosives

Alternatives for Bare UNO 1.3 Explosives Consumption - Table 11-40 shows the alternatives for bare UNO 1.3 explosives consumption at the Centrifuge Complex.

Table 11-40. Alternatives for Bare UNO 1.3 Explosives Consumption

Reduced Alternative		No Action Alternative						Expanded Alternative	
		Base Year		FY2003		FY2008			
0 pkgs	0 kg	0 pkgs	0 kg	0 pkgs	0 kg	0 pkgs	0 kg	10 pkgs	2,272 kg

Operations That Require Bare UNO 1.3 Explosives - UNO 1.3 explosives would be consumed during rocket motor firings under acceleration on the 35-ft outdoor centrifuge. This type of test is conducted on rocket motors that experience high lateral accelerations during a maneuver, such as those in a cruise missile. They have been conducted in the past, but not recently. However, the capability still exists and could be required in an “expanded” alternative.

Basis for Projecting the “Reduced” and “Expanded” Values - Only the expanded alternative shows UNO 1.3 explosives consumed (ten rocket motors with 227.2 kg of propellant each). This is an upper bound based on past history.

3.8.3.4.2 Explosives Consumption Scenario for Bare UNO 1.4 Explosives

Alternatives for Bare UNO 1.4 Explosives Consumption - Table 11-41 shows the alternatives for bare UNO 1.4 explosives consumption at the Centrifuge Complex.

Table 11-41. Alternatives for Bare UNO 1.4 Explosives Consumption

Reduced Alternative		No Action Alternative						Expanded Alternative	
		Base Year		FY2003		FY2008			
0 pkgs	0 g	0 pkgs	0 g	10 pkgs	89 g	10 pkgs	89 g	100 pkgs	890 g

Operations That Require Bare UNO 1.4 Explosives - UNO 1.4 explosives are used to release test objects from the centrifuge boom during impact tests. One cable cutter with 8.9 g of explosives is required per impact test.

Basis for Projecting the “Reduced” and “Expanded” Values - The basis for projecting the reduced and expanded values is a linear projection of one cable cutter required per each impact test.

3.8.3.4.3 Explosives Consumption Scenario for Bare UNO 1.1 Explosives

Alternatives for Bare UNO 1.1 Explosives Consumption - Table 11-42 shows the alternatives for bare UNO 1.1 explosives consumption at the Centrifuge Complex.

Table 11-42. Alternatives for Bare UNO 1.1 Explosives Consumption

Reduced Alternative		No Action Alternative						Expanded Alternative	
		Base Year		FY2003		FY2008			
0 pkgs	0 kg	0 pkgs	0 kg	0 pkgs	0 kg	0 pkgs	0 kg	10 pkgs	7 kg

Operations That Require Bare UNO 1.1 Explosives - Up to 700 g of UNO 1.1 may be detonated on the centrifuge arm under acceleration. This type of test has been conducted in the past and could be required in an “expanded” alternative.

Basis for Projecting the “Reduced” and “Expanded” Values - For the purpose of this planning exercise, the “expanded” alternative assumes that ten charges of 700 g of UNO 1.1 explosive would be consumed. However, there is no way of predicting in advance what the actual composition of the explosives would be.

3.8.4 Waste

3.8.4.1 Low-Level Radioactive Waste Scenario

Low-level radioactive waste is not produced at the Centrifuge Complex.

3.8.4.2 Transuranic Waste Scenario

Transuranic waste is not produced at the Centrifuge Complex.

3.8.4.3 Mixed Waste

3.8.4.3.1 Low-Level Mixed Waste Scenario

Low-level mixed waste is not produced at the Centrifuge Complex.

3.8.4.3.2 Transuranic Mixed Waste Scenario

Transuranic mixed waste is not produced at the Centrifuge Complex.

3.8.4.4 Hazardous Waste Scenario

3.8.4.4.1 Alternatives for Hazardous Waste at the Centrifuge Complex

Table 11-43 shows the alternatives for hazardous waste at the Centrifuge Complex.

Table 11-43. Alternatives for Hazardous Waste

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
12 kg	10 kg	12 kg	12 kg	15 kg

3.8.4.4.2 Operations That Generate Hazardous Waste

Test preparations involve machining to shape parts, application of epoxies to assemble test packages, painting of surfaces, and use of cleaning chemicals.

3.8.4.4.3 General Nature of Waste

Rags and empty containers contain chemical residues. See the list in “3.5 Hazards and Hazard Controls.”

3.8.4.4.4 Waste Reduction Measures

No waste reduction measures are in effect beyond those directed by SNL/NM Division 6000 procedures.

3.8.4.4.5 Basis for Projecting the “Reduced” and “Expanded” Values

Waste projections for the “reduced” and “expanded” alternatives are based on historical engineering experience for the activity levels projected in “3.8.1 Activity Scenarios.” Waste generation is not linear.

3.8.5 Emissions

3.8.5.1 Radioactive Air Emissions Scenarios

Radioactive air emissions are not produced at the Centrifuge Complex.

3.8.5.2 Chemical Air Emissions

Information on an extensive list of chemicals was obtained from the SNL/NM Chemical Inventory System (CIS). For the air emissions analysis, the entire annual inventory of these chemicals was assumed to have been released over a year of operations for each specific facility (i.e., the annual inventory was divided by facility operating hours). The emissions from this release were then subjected, on a chemical-by-chemical basis, to a progressive series of screening steps for potential exceedances of both regulatory and human health thresholds. For those chemicals found to exceed this screening, process knowledge was used to derive emission factors. The emission factors for these chemicals were then modeled using the U.S. Environmental Protection Agency's *Industrial Source Complex Air Quality Dispersion Model, Version 3*. The results of this modeling are discussed as part of the analysis in support of the SNL/NM site-wide environmental impact statement.

3.8.5.3 Open Burning Scenarios

The Centrifuge Complex does not have outdoor burning operations.

3.8.5.4 Process Wastewater Effluent Scenario

The Centrifuge Complex does not generate process wastewater.

3.8.6 Resource Consumption

3.8.6.1 Process Water Consumption Scenario

The Centrifuge Complex does not consume process water.

3.8.6.2 Process Electricity Consumption Scenario

The Centrifuge Complex does not consume process electricity.

3.8.6.3 Boiler Energy Consumption Scenario

The Centrifuge Complex does not consume energy for boilers.

3.8.6.4 Facility Personnel Scenario

3.8.6.4.1 Alternatives for Facility Staffing at the Centrifuge Complex

Table 11-44 shows the alternatives for facility staffing at the Centrifuge Complex.

Table 11-44. Alternatives for Facility Staffing

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
3.5 FTEs	3.5 FTEs	4.5 FTEs	4.5 FTEs	10 FTEs

3.8.6.4.2 Operations That Require Facility Personnel

Acceleration and impact testing require personnel. Table 11-45 shows the breakdown of FTEs for the “no action” alternative.

Table 11-45. FTEs for the No Action Alternative

Activities	SNL Staff			Contractors
	Engineers	Technicians	Administrative	
Acceleration testing	0.9	1.2	0.9	0
Impact testing	0.1	0.3	0.1	1.0
Totals	1.0	1.5	1.0	1.0

FY1998 FTE costs are \$800,000.

3.8.6.4.3 Staffing Reduction Measures

No staffing reduction measures exist.

3.8.6.4.4 Basis for Projecting the “Reduced” and “Expanded” Values

The “reduced” level is the amount of SNL personnel required to maintain the viability of the Centrifuge Complex.

Table 11-46 shows the breakdown of FTEs for the “reduced” alternative.

Table 11-46. FTEs for the Reduced Alternative

Activities	SNL Staff		
	Engineers	Technicians	Administrative
Acceleration testing	0.9	1.2	0.9
Impact testing	0.1	0.3	0.1
Totals	1.0	1.5	1.0

FY1998 FTE costs are \$800,000.

Table 11-47 shows the breakdown of FTEs for the “expanded” alternative.

Table 11-47. FTEs for the Expanded Alternative

Activities	SNL Staff			Contractors
	Engineers	Technicians	Administrative	
Acceleration testing	1.7	3	1.3	0
Impact testing	0.3	1.5	0.2	2.0
Totals	2.0	4.5	1.5	2.0

FY1998 FTE costs are \$1.8 million.

3.8.6.5 Expenditures Scenario

3.8.6.5.1 Alternatives for Expenditures at the Centrifuge Complex

Table 11-48 shows the alternatives for expenditures at the Centrifuge Complex.

Table 11-48. Alternatives for Expenditures

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
\$250,000	\$400,000	\$450,000	\$480,000	\$750,000

3.8.6.5.2 Operations That Require Expenditures

Centrifuge acceleration and impact testing require various expenditures. The major categories include hydraulic pumps and motors, test fixtures, data acquisition equipment, electrical and mechanical equipment, and tools and contract maintenance.

3.8.6.5.3 Expenditure Reduction Measures

No expenditure reduction measures exist.

3.8.6.5.4 Basis for Projecting the “Reduced” and “Expanded” Values

The “reduced” level of expenditures maintains the viability of the Centrifuge Complex.

Table 11-49 shows the breakdown for expenditures for the “reduced” alternative.

Table 11-49. Expenditures for the Reduced Alternative

Activity	Expenditure
Centrifuge acceleration testing	\$220,000
Centrifuge impact testing	\$30,000

Table 11-50 shows the expanded level of expenditures.

Table 11-50. Expenditures for the Expanded Alternative

Activity	Expenditure
Centrifuge acceleration testing	\$450,000
Centrifuge Impact testing	\$300,000

4.0 DROP/IMPACT COMPLEX SOURCE INFORMATION

4.1 Purpose and Need

The Drop/Impact Complex is an SNL test facility for hard-surface impacts, water impacts, and underwater tests of weapon shapes, substructures, and components to verify design integrity, performance, and fuzing functions. The DOE needs the Drop/Impact Complex to support research and development activities in the national interest on an as-available basis.

(Bomber *et al.*, 1996; U.S. Department of Energy, 1997)

4.2 Description

The Drop/Impact Complex consists of two towers:

- A 185-ft drop tower next to a hard surface
- A 300-ft drop tower next to a water-filled pool that is 120-ft wide, 188-ft long, and 50-ft deep. A 600-ft-long rocket sled track is located at the end of the pool opposite the tower for rocket pull-down accelerated impacts into the water pool.

The 185-ft drop tower is used to drop test items weighing up to 9,000 pounds onto prepared surfaces such as dirt, reinforced concrete, or steel plate. It has a cable stretched over the top of the tower to anchors on the ground. Test items weighing up to 2,000 pounds can slide down these cables on a carriage and be released to fall to a target with a horizontal as well as vertical component of velocity.

A guidewire system on the 185-ft drop tower is used to drop punch-type structural shapes to precise impacts on shipping containers.

Test items weighing up to 3,000 pounds can be impacted into the water pool from the 300-ft drop tower. They can be dropped or can be accelerated by rocket-assisted pull-down to strike the water at velocities up to 600 ft per second and angles from 30 to 90 degrees.

Submersion tests are conducted in the water pool. Explosive charges up to 1 lb may be detonated under water for underwater blast effects.

(U.S. Department of Energy, 1997)

4.3 Program Activities

Table 11-51 shows the program activities at the Drop/Impact Complex.

Table 11-51. Program Activities at the Drop/Impact Complex

Program Name	Activities at the Drop/Impact Complex	Category of Program	Related Section of the SNL Institutional Plan
Direct Stockpile Activities	Conduct environmental, safety, and survivability testing for nuclear weapon applications.	Programs for the Department of Energy	Section 6.1.1.1
Performance Assessment Science and Technology	Drop/impact testing of materials, components, and weapon systems. Includes water impact/entry testing at the Lake Facility.	Programs for the Department of Energy	Section 6.1.1.1
Hazardous and Radioactive Material Transportation	Test prototype nuclear materials packagings.	Programs for the Department of Energy	Section 6.1.4.4
Sustaining Critical Progress in Model Validation	Highly controlled environment to be used for high-velocity impact testing on hard surfaces, for water impact tests, and for underwater testing to validate models.	Major Programmatic Initiatives	Section 7.1.3
Other Federal Agencies	WFO activities include water impact and submersion testing.	Work for Non-DOE Entities (Work for Others)	Section 6.2.7

4.4 Operations and Capabilities

Operations at the Drop/Impact Complex include conducting drop tests, rocket pull-down tests, submersion tests, and underwater explosive effects tests, which involve the following support activities:

- Receival, storage, and handling of explosives, pyrotechnics, propellants
- Drop tower operations (rigging, hoisting, and winch operations)
- Fabrication and assembly of fixtures
- Mating of sleds and rockets
- Explosives ordnance disposal
- Setting up of explosive tests
- Electronic instrumentation and data recording
- Radioactive and chemical material recovery
- Telemetry
- Hazard area control
- System checking fire-control system
- Transporting test assemblies to test sites
- Rocket arming and launching
- Explosive arming and firing
- Abort procedures
- Misfire procedures
- Diving operations
- Photometrics
- Receival, storage, and handling of nuclear, radioactive, and chemical materials
- Post-launch and post-firing procedures

4.4.1 Drop Tests

Test items are suspended for the drop tower rigging, positioned over the intended target, and hoisted to the required height to achieve the desired impact velocity. Mechanical devices or explosive cable cutters release the test items. In some cases, the item dropped is a puncture device dropped onto a test item. Response data are recorded by ground recorders through hard wire. Video and high-speed framing cameras record impact events.

4.4.2 Water Impacts

Test articles are gravity-accelerated or pulled down by rocket into the water pool from an overhead cable suspended between the top of the 300-ft tower and the ground. The rocket pull-down technique is the same as that used at the Aerial Cable Facility Complex. Response

data are telemetered or hard-wired from the test articles to ground station recorders. Impact events are recorded by high-speed framing cameras above and below the water surface. A water braking system similar to that of the Sled Track Complex recovers the rocket sleds, and staff divers recover test items.

4.4.3 Submersion

Test items are lowered into the water pool for a specified time to verify their underwater integrity. Test results are usually determined by post-test inspection.

4.4.4 Underwater Explosive Effects

Explosive charges (1-lb limit) are detonated at specified distances from test items to determine underwater blast effects. Test results are usually determined by post-test inspection. Response data may be recorded through hard wire.

(U.S. Department of Energy, 1997)

4.5 Hazards and Hazard Controls

4.5.1 Explosive Materials

4.5.1.1 Hazards

The principle hazard associated with explosives, pyrotechnics, and propellants is the accidental detonation or deflagration of energetic material. Explosive components may be sensitive to heat, mechanical shock, static electricity, fire, or electromagnetic radiation.

During operations involving explosives, personnel are in close proximity to energetic material. Accidental ignition, deflagration, or detonation could cause severe injury or loss of life for multiple personnel.

4.5.1.2 Hazard Controls

Written technical work documents are utilized for all handling of explosives. These procedures are routinely developed by operating organizations and reviewed and approved by the various safety disciplines prior to commencing activities involving the handling of explosives. All personnel involved in a given activity are required to read and follow applicable technical work documents if they are to work with explosives.

All activities relating to the shipping and receiving of explosive materials are conducted in accordance with applicable DOE requirements, including U.S. Department of Energy (1996). Technical work documents include requirements for the use of grounding straps, properly approved electrical equipment, access control, and other physical and administrative controls.

4.5.2 Radioactive Materials

4.5.2.1 Hazards

Radioactive materials associated with testing at the Drop/Impact Complex include the following:

- Depleted uranium
- Thorium alloys and compounds
- Uranium alloys
- Tritium

The most common radioactive material utilized is depleted uranium, which has a very low specific activity (1.0 $\mu\text{Ci/g}$). A typical weapon assembly may have up to several kg of depleted uranium inside, which will produce gamma radiation at the case surface of up to 1 mrem per hour. However, personnel have relatively short exposures to these assemblies during integration and tests. Annual radiation exposure to personnel is not expected to exceed 100 mrem per year. On this basis, facility personnel are not required to wear film badges such as the thermoluminescent dosimeter.

Radioactive material is always contained in sealed, weaponized assemblies when delivered to the complex. These assemblies are not opened during or after tests. Impact velocities are very low in relation to velocities that are required to rupture the weapons assemblies and to release depleted uranium. There have been no releases of depleted uranium to the environment at this facility.

4.5.2.2 Hazard Controls

Either the Explosives Storage Team or the Nuclear/General Material Storage Team delivers assemblies and components with radioactive material to the Drop/Impact Complex. The former team must provide transportation and handling if explosives are included in the test unit. Assemblies are checked for radioactive surface contamination by trained health physics personnel who conduct swipe tests of the shipping container, if used, and the test unit. In addition, these personnel measure the average magnitude of gamma emission from the test unit at the surface and at a nominal distance of 1 m.

4.5.3 Chemical Materials

4.5.3.1 Hazards

Small amounts of chemicals are used in test preparations. For example, various adhesives and epoxies are used to fasten transducers and similar items. Cleaners, lubricants, solvents, paints, and agents that might be used in small quantities include the following:

- Grease
- WD-40
- Soldering paste
- Spray paint
- Solder
- Soldering flux

4.5.3.2 Hazard Controls

Chemical usage is small. Chemicals are in 1-gal containers or less. Standard procedures outlined in Sandia National Laboratories (1999) dictate that the amount of chemicals present in the assembly areas at any one time be limited to the minimum amount needed for the performance of the work. All chemicals are stored in approved chemical storage cabinets when not in use.

4.5.4 Fabrication and Assembly of Fixtures

4.5.4.1 Hazards

Fabrication and assembly operations involve industrial accidents, hoisting and lifting accidents, and electrical shock.

4.5.4.2 Hazard Controls

Fabrication of mechanical components is performed on standard industrial machines in the Building 6741 workshop and highbay. SNL and contractor personnel utilizing these machines must first have classroom training on each type of machine employed. The responsible department manager certifies the adequacy and currency of this training. Machine guarding safety shields and operator PPE is required and utilized as specified in Sandia National Laboratories (1999).

Crane utilization and hoisting and lifting operations are performed only by SNL and contractor personnel who have attended RGH-100. Utilization, inspection, and periodic maintenance of cranes and hoists in Center 9100 is specified by an operating procedure.

Electrical shock hazards are mitigated in part by specific training designed to cover each generic type of hazard. Bundy (1996) specifies training for electrical safety. The use of ground fault circuit interrupters, double-insulated power tools, and grounding/bonding techniques mitigate electrical shock hazards wherever possible.

4.5.5 Mating of Sleds and Rockets

4.5.5.1 Hazards

The hazards encountered during the sled and rocket motor mating are related to accidental ignition of the rocket motors.

4.5.5.2 Hazard Controls

Intrinsic and fundamental requirements of operational technical work documents include shorting, grounding, and bonding electrical connections to initiators; use of personal wriststraps; and maintenance of a static-free environment during explosives handling operations. Monitoring of the Lightning Early Warning System is also mandatory. All explosive activities are terminated when the potential gradient reaches 2,000 volts per m.

4.5.6 Drop Tower Operations

4.5.6.1 Hazards

Drop tower operations involve several potentially serious industrial hazards associated with suspended loads, hoisting, and winching operations:

- Towing or hoisting cables and associated hardware can fail under load.
- Cables failing under load can recoil and flail and severely injure nearby personnel.
- Winching equipment and moving cables can severely injure personnel.

4.5.6.2 Hazard Controls

Winching and hoisting operations are performed by specially trained personnel who have completed formal on-the-job training for winching and hoisting operations that includes classroom and hands-on field training. During hoisting operations, the test director communicates instructions by radio to the winch operators from a location where all movement is visible.

Only those personnel required to guide the test items and rigging are allowed under the suspended hardware.

4.5.7 Diving Operations

4.5.7.1 Hazards

Diving operation hazards include the following:

- Drowning
- Underwater hoisting
- Decompression sickness
- Entanglement in underwater rigging
- Contaminated breathing air
- Pressurized air cylinders

4.5.7.2 Hazard Controls

All divers are SCUBA certified, have had the PADI SCUBA course, and make annual training dives under the direction of an experienced trainer. In addition, all divers receive CPR training, first aid training, RGH100 (Crane, Rigging, Hoisting and hands-on Training) and XPL (Explosives Safety) training.

The safety equipment used for diving includes depth gauges, regulators, pressure gauges, air cylinders, breathing hoses, and wet/dry suits. Grade D breathing air is used for all diving operations. The water treatment chemicals used at the Water Impact Facility are approved by SNL industrial hygiene, and their MSDSs are on file at the facility.

4.5.8 Explosive Test Setup

4.5.8.1 Hazards

The primary hazard encountered during explosive test setup is the accidental detonation of the explosives.

4.5.8.2 Hazard Controls

All of the controls described above for the mating of sleds and rockets apply to the setting up of explosives.

4.5.9 Electronic Instrumentation, Photometrics, and Telemetry

4.5.9.1 Hazards

Field setup of electronic and photometrics instrumentation can involve industrial hazards, falling or tripping, electrical shocks from power distribution equipment, and weather-related hazards. These operations do not generally involve exposure of personnel to the test hazards. These personnel are located out of the controlled hazard area during tests.

Telemetry systems aboard payload assemblies introduce hazards from electrical sources of energy from batteries and from the potential for cross wiring or “sneak circuits” that could accidentally fire an explosive initiator. Additional hazards are introduced by the chemical nature of the batteries themselves. Explosive gases may be created by charge or discharge actions, chemical spills of corrosive or acidic materials can occur, and the battery case can explode under certain conditions. Thermal batteries can present all of the above hazards plus a burn hazard to personnel. Personnel associated with telemetry receiving operations are located out of the controlled hazard area during tests.

4.5.9.2 Hazard Controls

The hazards presented by incorporating onboard telemetry systems with systems that use explosives are potentially severe. Explosives ignitors are installed as late as possible in the buildup and then are disconnected and shorted during telemetry checkout. A technical work document designed for this integration process contains a checklist designed for the step-by-step procedure.

Hazards encountered during field setup of instrumentation are mitigated by safety training awareness on the use of ladders and platforms, foul-weather clothing, and multiperson teams

for work in remote locations. Workers who regularly work in remote locations are encouraged to take CPR and first-aid training courses available through the SNL Medical Center. Electrical shock hazards during field setup activities are mitigated by electrical safety training, use of ground fault circuit interrupter equipment, double-insulated electric hand tools, and the use of grounding/bonding techniques.

4.5.10 Hazard Area Control

4.5.10.1 Hazards

Personnel who enter the hazard area of a test at the Drop/Impact Complex either deliberately or accidentally without the expressed knowledge and permission of the launch controller could be seriously injured or killed by blast, impact, or shrapnel.

4.5.10.2 Hazard Controls

The hazard area footprint is based on the worst case, maximum energy event conceivable. See Table 11-52.

Table 11-52. Ground Hazard Area at the Drop/Impact Complex

Activities	Ground Hazard Areas
Loading of rockets on sleds	A cone of 23 degrees around the centerline of the track of 2,000 ft in length with an apex at the northeast end and a 400-ft radius at the beginning of the track
Pull-down tests from the 300-ft tower	Radius of 400 ft
Drop tests from the 300-ft tower	Radius of 400 ft
Drop tests from the 185-ft tower	Radius of 300 ft

A network of manned roadblocks, barriers, and observers communicating by radio with the launch controller provides a continuous visual watch for unauthorized entry into the hazard area. Observers can instantly stop the countdown by radio.

4.5.11 Rocket Motor and Explosives Arming and Firing

4.5.11.1 Hazards

The final arming crew is in close proximity to major sources of energetic materials during the arming procedure. Accidental ignition of a rocket motor or explosive would almost certainly result in the serious injury or death of the crew.

4.5.11.2 Hazard Controls

Explosives hazards to the final arming crew are mitigated by a combination of administrative and engineered controls designed to positively prevent an accidental initiation of rocket motors and explosives. The crew size is two persons, which allows each person to perform a mutual check and verification of each procedural step. They are highly trained and experienced in explosive ordnance technology and highly knowledgeable about the electrical arming and firing system at the Drop/Impact Complex. They follow a rigorous operating procedure and checklist designed for the specific hazards of the rocket motors and explosives involved in the tests. The crew cannot arm the rocket motors and explosives without having the “firing enable” key in their possession. Without this key in the control panel, it is not possible to supply charging voltage to the fireset. Prior to connecting explosives initiators, the crew performs a stray voltage measurement on the connectors before actually inserting them. Both crew members use a checklist procedure to verify that each step is completed.

When the final arming crew returns to the control point, a final radio check is performed for all personnel clear of the hazard area. If the area is clear, the launch controller inserts the enable key into the control panel and energy is applied to the firing system. The firing sequence is started and the countdown begins.

4.5.12 Abort and Misfire Procedures

4.5.12.1 Hazards

An abort is the deliberate action of stopping a test countdown due to some event that precludes conducting the test as planned. It could be for a safety reason, such as an unauthorized entry into the hazard area, or for a technical reason such as a data recording system failure. If the reason for the abort can be corrected in a reasonable amount of time, the test can resume. A misfire is the unexpected failure of the primary test event (rocket motor firing or explosive detonation). The test countdown may be repeated if the cause of the misfire can be diagnosed (such as failure of the firing system to arm). However, if the reason for the abort or the cause of the misfire can not be corrected, the test event has to be made safe.

4.5.12.2 Hazard Controls

A wait of 30 minutes must be observed before the arming crew enters the hazard area to safe the test event unless it were known that the firing system had not been armed prior to the abort.

The arming crew must have the “firing enable” key in their possession when they enter the hazard area to safe the test event. The arming crew disconnects the explosive initiators from

the firing system. The initiators are shorted and grounded prior to opening the hazard area for correcting the cause of the abort or misfire or prior to the removal of the test assembly from the Drop/Impact Complex.

4.5.13 Post-Launch and Firing Procedures, Explosive Ordnance Disposal, and Radiation and Chemical Material Recovery

4.5.13.1 Hazards

Serious injury or death could result from the rapid deflagration or detonation of residual energetic materials. SNL personnel and KAFB personnel could suffer smoke inhalation and minor burns while fighting a grass fire.

4.5.13.2 Hazard Controls

The reentry/recovery team does not enter the hazard area after a test until all available quick-look information regarding the test has been reviewed. The team is advised about potential residual hazards that would result from a known test anomaly. The team has also carefully reviewed and signed the technical work documents, which describe the hazards. They pay particular attention to the portions of the technical work documents that describe recovery hazards that might result from normal, anticipated test results and possible test failure scenarios. The hazard area remains closed to all other personnel until the reentry/recovery team pronounces it safe. If the KAFB EOD team must be called in to dispose of residual explosives hazards, the cordoned area around the explosives remains closed until KAFB EOD team pronounces it safe.

If toxic chemicals are disbursed, the SNL EOD crew arranges for cleanup response from the Waste Operations Department. The latter two organizations have trained response teams with proper PPE and tools to safely contain and clean up radioactive and toxic debris. Legacy residuals in the soil are not known to exist and have not been encountered.

SNL personnel assisting in grass fire control have received instruction and training from the KAFB Fire Department. The KAFB on-scene fire chief is in command of all Air Force and SNL personnel who fight a grass fire. The fire chief assigns the least hazardous duty to the shovel-equipped SNL personnel, and he enlists their help only if absolutely necessary.

4.5.14 Operational Effects on the Environment

4.5.14.1 Hazards

Environmental consequences associated with operations at the Drop/Impact Complex include air emissions from rocket motors and explosives; liquid effluent from the water brake section of the track; solid waste from test debris; hazardous waste explosives and chemicals; scarring of the ground due to target construction, impact of test items and occasional grass fires; and high noise levels from rocket motors and explosives.

4.5.14.2 Hazard Controls

Gases and particles emitted by booster rocket motors account for most of the emissions at the complex. The total annual emissions account for only 2.2 percent of the total emissions of the Albuquerque Full-Scale Experimental Complex. None of the tests approach levels requiring a burn permit as required in Sandia National Laboratories (1998).

Exhaust gases do not contain products at levels reportable to the National Response Center. The types and quantities of explosives and rocket motors are addressed in U.S. Department of Energy (1997). For additional details of rocket motor chemical composition and their exhaust gases see Chemical Propulsion Information Agency (1994).

Recoverable rocket sleds have scoops to engage water in a trough for breaking. About 50 gal of water is discharged in a spray that either evaporates while airborne or falls upon the road beside the track.

Test debris may contain hazardous waste. Drop/Impact Complex personnel who have completed all appropriate modules of the hazardous waste training program separate and containerize the hazardous waste after tests.

Earthen construction is for the purpose of test preparation and involves areas already disturbed. Construction equipment and personnel are monitored for radiation contamination as required by RMMA control procedures so that radioactive materials are not inadvertently buried. Approximately one acre is involved.

Tests are not conducted in wind conditions higher than 25 mph in order to minimize the spread of grass fires.

The maximum noise level of 135 dB at the complex from rocket motors decreases to 117 dB at the hazard area boundary. Noise levels further decrease over distance so that at the nearest

populated area they would range between 92 and 99 dB, which is less than noise from vehicular traffic and aircraft.

(Abeyta, 1997; Bickel, 1998; Bomber *et al.*, 1996; Garcia, 1998)

4.6 Accident Analysis Summary

The Drop/Impact Complex has been found to be a low-hazard nonnuclear facility by SNL primary hazard screening process and does not require a safety analysis report. A follow-up hazards analysis is planned but is not expected to change the earlier finding.

4.7 Reportable Events

The Drop/Impact Complex has had no occurrences over the past five years.

4.8 Scenarios for Impact Analysis

In all of the scenarios for impact analysis in this section, base year values are for fiscal year (FY) 1996 unless otherwise noted.

4.8.1 Activity Scenarios

4.8.1.1 Scenario for Test Activities: Drop Test

4.8.1.1.1 Alternatives for Test Activities: Drop Test

Table 11-53 shows the alternatives for drop tests at the Drop/Impact Complex.

Table 11-53. Alternatives for Test Activities: Drop Test

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
0 tests	18 tests	20 tests	20 tests	50 tests

4.8.1.1.2 Assumptions and Actions for the “Reduced” Values

The value for the “reduced” alternative assumes that no tests will be conducted. For this to occur, there would have to be a cessation of testing in weapons modification and recertification of shipping containers. Exercising this activity would not be required to maintain viability.

Actual testing is not required to maintain facility capability for drop tests; however, technical skills and equipment would need to be kept current in order to resume this testing within a reasonable startup time.

4.8.1.1.3 Assumptions and Rationale for the “No Action” Values

The user survey, reported in Bomber *et al.* (1996), forecasts 20 drop test per year to certify modification to weapons and recertify shipping containers. Test objects are suspended from the drop tower rigging, positioned over the intended target, hoisted to the required height to achieve the desired impact velocity, and released by mechanical devices or explosive cable cutters. In some tests, a puncture device is dropped onto the test object. Response data are recorded through hard wire. Video and high-speed motion photography record impact events.

Projections provided for the base year are actuals. The FY2003 and FY2008 projections represent anticipated activity levels based on recent historical levels (last five years) of effort at this facility. The number of tests identified for these timeframes could occur over an operational year or within a single month of an operational year, depending on the amount of required test setup time. In addition, an operational year is driven by test demand.

4.8.1.1.4 Assumptions and Actions for the “Expanded” Values

Testing at the aerial cable would likely encompass the majority of test requirements. Tests using the drop tower would provide added support should surge capability be required.

The values for the “expanded” alternative assume an increase in weapon modification certification, container recertification, and weapons research programs. These projections assume one test per week over a 50-week operational year. This would represent a level of activity that the facility could accommodate yet at which it historically has never operated. The consumption of UNO 1.3 and UNO 1.4 explosives and expenditures would increase, and additional personnel would be needed.

4.8.1.2 Scenario for Test Activities: Water Impact

4.8.1.2.1 Alternatives for Test Activities: Water Impact

Table 11-54 shows the alternatives for water impact tests at the Drop/Impact Complex.

Table 11-54. Alternatives for Test Activities: Water Impact

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
1 test	1 test	1 test	1 test	20 tests

4.8.1.2.2 Assumptions and Actions for the “Reduced” Values

Test objects are suspended from an overhead cable running between the top of the 300-ft drop tower and the ground. They are gravity-accelerated or pulled down by rockets into a 50-ft deep water target. The rocket pull-down technique is the same as that used at the Aerial Cable Facility Complex. Response data are telemetered or hard-wired from the test articles to ground station recorders. Impact events are recorded by high-speed framing cameras above and below the water surface. A water braking system similar to that of the Sled Track Complex recovers the rocket sleds, and staff divers recover test items.

The projections under this alternative assume one test per year to maintain the viability of this activity and certification of staff divers.

4.8.1.2.3 Assumptions and Rationale for the “No Action” Values

Projections provided for the base year are actuals. The FY2003 and FY2008 projections represent anticipated activity levels based on recent historical levels of effort (last five years) at this facility. The out-year projections assume a request for at least one water impact test per year to certify weapons modification.

4.8.1.2.4 Assumptions and Actions for the “Expanded” Values

The value for the “expanded” alternative assumes an increase in weapon modification certifications, Work for Others program activities, and weapons research program activities. This would represent a level of activity that the facility could accommodate, yet at which the facility has historically never operated.

Consumption of UNO 1.3 and 1.4 explosives and expenditures would increase, and additional personnel would be needed.

4.8.1.3 Scenario for Test Activities: Submersion**4.8.1.3.1 Alternatives for Test Activities: Submersion**

Table 11-55 shows the alternatives for submersion tests at the Drop/Impact Complex.

Table 11-55. Alternatives for Test Activities: Submersion

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
0 tests	1 tests	1 tests	1 tests	5 tests

4.8.1.3.2 Assumptions and Actions for the “Reduced” Values

Test objects are lowered into the 50-ft water target for a specified time to certify their underwater integrity. Test results are determined by post-test inspection.

The value for the “reduced” alternative assumes that no submersion tests would be conducted. For this to occur, there would have to be a cessation of testing for shipping container recertification and Energy and Environment programs. Exercising this activity would not be required to maintain viability. This activity will be available as long as the water impact activity is maintained.

Actual testing is not required to maintain facility capability for drop tests; however, technical skills and equipment would need to be kept current in order to resume this testing within a reasonable startup time.

4.8.1.3.3 Assumptions and Rationale for the “No Action” Values

Projections provided for the base year are actuals. The FY2003 and FY2008 projections represent anticipated activity levels based on recent historical levels (last five years) of effort at this facility. The out-year projections assume a request for at least one submersion test per year to certify shipping container design.

4.8.1.3.4 Assumptions and Actions for the “Expanded” Values

The value for the “expanded” alternative assumes an increase in shipping container certifications and research programs. This would represent a level of activity that the facility could accommodate, yet at which the facility has historically not operated.

4.8.1.4 Scenario for Test Activities: Underwater Blast**4.8.1.4.1 Alternatives for Test Activities: Underwater Blast**

Table 11-56 shows the alternatives for underwater blast tests at the Drop/Impact Complex.

Table 11-56. Alternatives for Test Activities: Underwater Blast

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
0 tests	0 tests	2 tests	2 tests	10 tests

4.8.1.4.2 Assumptions and Actions for the “Reduced” Values

The value for the “reduced” alternative assumes no tests would be conducted. For this to occur, there would have to be a cessation for certifications of weapon modifications and Work for Others program activities. Exercising this activity would not be required to maintain viability. This activity would be available as long as the water impact capability is available.

Actual testing is not required to maintain facility capability for underwater blast tests; however, technical skills and equipment would need to be kept current in order to resume this testing within a reasonable startup time.

4.8.1.4.3 Assumptions and Rationale for the “No Action” Values

There were no underwater blast tests during the base year.

The FY2003 and FY2008 timeframes assume that two underwater blast tests would be conducted per year. The projection of two tests is based on the historical knowledge that underwater testing takes place in series.

4.8.1.4.4 Assumptions and Actions for the “Expanded” Values

The value for the “expanded” alternative assumes an increase in weapon modification certifications, Work for Others program activities, and weapons research program activities. This would represent a level of activity that the facility could accommodate yet at which it historically has never operated.

UNO 1.3 and UNO 1.4 explosives consumption and expenditures would increase, and additional personnel would be required.

4.8.2 Material Inventories

4.8.2.1 Nuclear Material Inventory Scenario for Depleted Uranium

4.8.2.1.1 Alternatives for Depleted Uranium Nuclear Material Inventory

Table 11-57 shows the alternatives for the depleted uranium inventory at the Drop/Impact Complex.

Table 11-57. Alternatives for Depleted Uranium Nuclear Material Inventory

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
0 kg	0 kg	0 kg	0 kg	0 kg

4.8.2.1.2 Operations That Require Depleted Uranium

There are no operations at the Drop/Impact Complex that require depleted uranium or any other nuclear material. However, nuclear material may be included in objects being tested to authenticate certification of a system. As such, they do not contribute to the operation but are subjected to it.

Ownership of the material being tested does not transfer to the management of the Drop/Impact Complex. The materials are maintained under SNL/NM security and kept in safe-secure facilities for a period of one to a few days. The inventory function is maintained by the security organization, and accountability remains with the organization that requests the test. As such, there is never an administrative inventory of these materials at the Drop/Impact Complex.

4.8.2.1.3 Basis for Projecting the “Reduced” and “Expanded” Values

This section is not applicable.

4.8.2.2 Radioactive Material Inventory Scenarios

The Drop/Impact Complex has no radioactive material inventories.

4.8.2.3 Sealed Source Inventory Scenarios

The Drop/Impact Complex has no sealed source inventories.

4.8.2.4 Spent Fuel Inventory Scenarios

The Drop/Impact Complex has no spent fuel inventories.

4.8.2.5 Chemical Inventory Scenarios

The Drop/Impact Complex has no inventories of chemicals of concern.

4.8.2.6 Explosives Inventory Scenarios

4.8.2.6.1 Explosives Inventory Scenario for Bare UNO 1.4

Alternatives for Bare UNO 1.4 Explosives Inventory - Table 11-58 shows the alternatives for bare UNO 1.4 explosives inventory at the Drop/Impact Complex.

Table 11-58. Alternatives for Bare UNO 1.4 Explosives Inventory

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
0 g	0 g	0 g	0 g	0 g

Operations That Require Bare UNO 1.4 - Explosive inventory is managed through the SNL Explosive Inventory System. Explosives are delivered to the Drop/Impact Complex on a just-in-time basis. While they are at the complex, explosives are accounted for within the SNL Explosive Inventory System until they are consumed. Explosives not consumed during testing are returned to the storage complex.

Basis for Projecting the “Reduced” and “Expanded” Values - This section is not applicable.

4.8.2.7 Other Hazardous Material Inventory Scenarios

The Drop/Impact Complex has no inventories of hazardous materials that do not fall into the categories of nuclear or radioactive material, sealed sources, spent fuel, explosives, or chemicals.

4.8.3 Material Consumption

4.8.3.1 Nuclear Material Consumption Scenario for Depleted Uranium

4.8.3.1.1 Alternatives for Depleted Uranium Consumption

Table 11-59 shows the alternatives for depleted uranium consumption at the Drop/Impact Complex.

Table 11-59. Alternatives for Depleted Uranium Consumption

Reduced Alternative		No Action Alternative						Expanded Alternative	
		Base Year		FY2003		FY2008			
0 pkgs	0 kg	0 pkgs	0 kg	0 pkgs	0 kg	0 pkgs	0 kg	0 pkgs	0 kg

4.8.3.1.2 Operations That Require Depleted Uranium

No operation at the Drop/Impact Complex requires depleted uranium or any other nuclear material. Nuclear material is included within objects being tested to authenticate certification of systems. Thus, the nuclear material is subjected to testing at the complex. Nuclear material subjected to testing is recovered after tests and returned to the test requester. See “4.8.2.1 Nuclear Material Inventory Scenario for Depleted Uranium.”

4.8.3.1.3 Basis for Projecting the “Reduced” and “Expanded” Values

This section is not applicable.

4.8.3.2 Radioactive Material Consumption Scenarios

Radioactive material is not consumed at the Drop/Impact Complex.

4.8.3.3 Chemical Consumption Scenarios

Information initially provided for this section resides in the Facility Information Manager database and will be made available to the analysts responsible for preparing the sitewide environmental impact statement.

4.8.3.4 Explosives Consumption Scenarios

4.8.3.4.1 Explosives Consumption Scenario for Bare UNO 1.1 Explosives

Alternatives for Bare UNO 1.1 Explosives Consumption - Table 11-60 shows the alternatives for bare UNO 1.1 explosives consumption at the Drop/Impact Complex.

Table 11-60. Alternatives for Bare UNO 1.1 Explosives Consumption

Reduced Alternative		No Action Alternative						Expanded Alternative	
		Base Year		FY2003		FY2008			
0 pkgs	0 kg	0 pkgs	0 kg	0 pkgs	0 kg	0 pkgs	0 kg	10 pkgs	6.8 kg

Operations That Require Bare UNO 1.1 Explosives - No UNO 1.1 explosives will be required for the reduced alternative. Explosive charges of C4, TNT, or HMX are required for underwater blast tests.

Basis for Projecting the “Reduced” and “Expanded” Values - The “expanded” values are ten charges of 1.5 lb each, which represent the facility design limit.

4.8.3.4.2 Explosives Consumption Scenario for Bare UNO 1.4 Explosives

Alternatives for Bare UNO 1.4 Explosives Consumption - Table 11-61 shows the alternatives for bare UNO 1.4 explosives at the Drop/Impact Complex.

Table 11-61. Alternatives for Bare UNO 1.4 Explosives Consumption

Reduced Alternative		No Action Alternative						Expanded Alternative	
		Base Year		FY2003		FY2008			
4 pkgs	36 g	22 pkgs	196 g	24 pkgs	214 g	24 pkgs	214 g	130 pkgs	1,157 g

Operations That Require Bare UNO 1.4 Explosives - UNO 1.4 explosives (cable cutters) are used during drop and water impact tests to release test objects from the overhead cable and to cut the towing cables just prior to impact on water impact tests.

Basis for Projecting the “Reduced” and “Expanded” Values - The “reduced” and “expanded” values are based on linear projections of test levels. Two cable cutters are required on drop tests, and four are required on water impact tests. This assumes an average of 8.9 g per cutter times 2 per drop and times 4 per water impact.

4.8.3.4.3 Explosives Consumption Scenario for Bare UNO 1.3 Explosives

Alternatives for Bare UNO 1.3 Explosives Consumption - Table 11-62 shows the alternatives for bare UNO 1.3 explosives consumption at the Drop/Impact Complex.

Table 11-62. Alternatives for Bare UNO 1.3 Explosives Consumption

Reduced Alternative		No Action Alternative						Expanded Alternative	
		Base Year		FY2003		FY2008			
6 pkgs	55 kg	6 pkgs	55 kg	6 pkgs	55 kg	6 pkgs	55 kg	120 pkgs	1,100 kg

Operations That Require Bare UNO 1.3 Explosives - UNO 1.3 explosives (rocket motors) are the pull-down propulsion for water impact tests.

Basis for Projecting the “Reduced” and “Expanded” Values - The “reduced” and “expanded” values are based on linear projection of test levels. Up to 6 HVAR rocket motors may be required per water impact test.

4.8.4 Wastes

4.8.4.1 Low-Level Radioactive Waste Scenario

Low-level radioactive waste is not produced at the Drop/Impact Complex.

4.8.4.2 Transuranic Waste Scenario

Transuranic waste is not produced at the Drop/Impact Complex.

4.8.4.3 Mixed Waste

4.8.4.3.1 Low-Level Mixed Waste Scenario

Low-level mixed waste is not produced at the Drop/Impact Complex.

4.8.4.3.2 Transuranic Mixed Waste Scenario

Transuranic mixed waste is not produced at the Drop/Impact Complex.

4.8.4.4 Hazardous Waste Scenario

4.8.4.4.1 Alternatives for Hazardous Waste at the Drop/Impact Complex

Table 11-63 shows the alternatives for hazardous waste at the Drop/Impact Complex.

Table 11-63. Alternatives for Hazardous Waste

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
0 g	0 g	0 g	0 g	0 g

4.8.4.4.2 Operations That Generate Hazardous Waste

Lead residuals from rocket motor firings scatter back to the ground but are very unlikely to be reclaimed as waste. Quantities at issue are on the order of several grams per year.

4.8.4.4.3 General Nature of Waste

The waste is lead from rocket fuel.

4.8.4.4.4 Waste Reduction Measures

No waste reduction measures exist.

4.8.4.4.5 Basis for Projecting the “Reduced” and “Expanded” Values

Projections of the “reduced” and “expanded” values are based on facility expertise.

4.8.5 Emissions

4.8.5.1 Radioactive Air Emissions Scenarios

Radioactive air emissions are not produced at the Drop/Impact Complex.

4.8.5.2 Chemical Air Emissions

Information on an extensive list of chemicals was obtained from the SNL/NM Chemical Inventory System (CIS). For the air emissions analysis, the entire annual inventory of these chemicals was assumed to have been released over a year of operations for each specific

facility (i.e., the annual inventory was divided by facility operating hours). The emissions from this release were then subjected, on a chemical-by-chemical basis, to a progressive series of screening steps for potential exceedances of both regulatory and human health thresholds. For those chemicals found to exceed this screening, process knowledge was used to derive emission factors. The emission factors for these chemicals were then modeled using the U.S. Environmental Protection Agency's *Industrial Source Complex Air Quality Dispersion Model, Version 3*. The results of this modeling are discussed as part of the analysis in support of the SNL/NM site-wide environmental impact statement.

4.8.5.3 Open Burning Scenarios

The Drop/Impact Complex does not have outdoor burning operations.

4.8.5.4 Process Wastewater Effluent Scenario

The Drop/Impact Complex does not generate process wastewater.

4.8.6 Resource Consumption

4.8.6.1 Process Water Consumption Scenario

The Drop/Impact Complex does not consume process water.

4.8.6.2 Process Electricity Consumption Scenario

The Drop/Impact Complex does not consume process electricity.

4.8.6.3 Boiler Energy Consumption Scenario

The Drop/Impact Complex does not consume energy for boilers.

4.8.6.4 Facility Personnel Scenario

4.8.6.4.1 Alternatives for Facility Staffing at the Drop/Impact Complex

Table 11-64 shows the alternatives for facility staffing at the Drop/Impact Complex.

Table 11-64. Alternatives for Facility Staffing

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
2.5 FTEs	2.5 FTEs	2.5 FTEs	2.5 FTEs	8 FTEs

4.8.6.4.2 Operations That Require Facility Personnel

Drop, water impact, submersion, and underwater blast tests require SNL staff and contractor personnel. Table 11-65 shows the breakdown of FTEs for the “no action” and “reduced” alternatives.

Table 11-65. FTEs for the No Action and Reduced Alternatives

Activities	SNL Staff			Contractors
	Engineers	Technicians	Administrative	
Drop testing	0	0.5	0.3	0.5
Water impact testing	0	0.2	0.1	0.2
Submersion testing	0	0.1	0	0.1
Underwater blast testing	0	0.2	0.1	0.2
Totals	0	1	0.5	1

FY98 FTE costs are \$400,000.

4.8.6.4.3 Staffing Reduction Measures

No staffing reduction measures exist.

4.8.6.4.4 Basis for Projecting the “Reduced” and “Expanded” Values

The value for the “reduced” alternative indicates the number of personnel that are required to maintain the viability of the activities at the Drop/Impact Complex. The breakdown is the same as that of the “no action” alternative.

Table 11-66 shows the breakdown of FTEs for the expanded alternative.

Table 11-66. FTEs for the Expanded Alternative

Activities	SNL Staff			Contractors
	Engineers	Technicians	Administrative	
Drop testing	0.1	1.2	0.5	1
Water impact testing	0.3	1.2	0.2	1
Submersion testing	0	0.3	0.1	0.3
Underwater blast testing	0.1	0.8	0.2	0.7
Totals	0.5	3.5	1	3

FTE costs in FY1998 dollars are \$1.2 million.

4.8.6.5 Expenditures Scenario

4.8.6.5.1 Alternatives for Expenditures at the Drop/Impact Complex

Table 11-67 shows the alternatives for expenditures at the Drop/Impact Complex.

Table 11-67. Alternatives for Expenditures

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
\$31,000	\$50,000	\$55,000	\$60,000	\$146,000

4.8.6.5.2 Operations That Require Expenditures

Drop, water impact, submersion, and underwater blast tests require expenditures. The major expenditure categories are targets, explosives, chemicals for the water target, electrical and mechanical equipment, and tools and contract maintenance.

Table 11-68 shows a breakdown of the “no action” alternative for expenditures.

Table 11-68. Expenditures for the No Action Alternative

Activity	Expenditure
Drop testing	\$22,000
Water impact testing	\$27,000
Submersion testing	\$1,000
Underwater blast testing	\$5,000
Total	\$55,000

4.8.6.5.3 Expenditure Reduction Measures

No expenditure reduction measures exist.

4.8.6.5.4 Basis for Projecting the “Reduced” and “Expanded” Values

Expenditures included in the “reduced” alternative are for maintaining the viability of the Drop/Impact Complex and staff diving capability.

Table 11-69 shows a breakdown of the expenditures for the “reduced” alternative.

Table 11-69. Expenditures for the Reduced Alternative

Activity	Expenditure
Drop testing	\$10,000
Water impact testing	\$18,000
Submersion testing	\$1,000
Underwater blast testing	\$2,000
Total	\$31,000

Table 11-70 shows a breakdown of the expenditures for the “expanded” alternative.

Table 11-70. Expenditures for the Expanded Alternative

Activity	Expenditure
Drop testing	\$25,000
Water impact testing	\$100,000
Submersion testing	\$1,000
Underwater blast testing	\$20,000
Total	\$146,000

5.0 TERMINAL BALLISTICS FACILITY SOURCE INFORMATION

5.1 Purpose and Need

The Terminal Ballistics Facility provides test environments for ballistic studies and solid-fuel rocket motor tests. The Terminal Ballistics Facility is needed to provide secure, remote, indoor and outdoor test facilities.

Typical tests include the following:

- Armor evaluation
- Impact studies
- High-level acceleration
- Functional and accuracy firing
- Access delay studies
- Penetration phenomena
- Vulnerability
- Flight dynamics
- Rocket thrust time curves

(U.S. Department of Energy, 1994; 1997)

5.2 Description

The Terminal Ballistics Facility in Tech Area III is a low-hazard facility that includes a main building (Building 6750), two smaller buildings (Building 6752 and Building 6753), and four explosive storage magazines. Building 6750 houses a small machine shop, office space, a control area, and an indoor firing range. Building 6753 is used for large propellant charge assembly and temperature conditioning of propellants. The storage magazines are used for long-term storage of propellants and explosives.

The complex includes an outdoor, large-caliber gun range aimed in a southerly direction from Building 6750. This outdoor range has a 155-mm “Long Tom” artillery gun permanently mounted in a revetment adjacent to Building 6750. Static-fire rocket stands, which are used to measure the thrust force of small rockets, are located on the west side within the perimeter fence around Building 6750.

(U.S. Department of Energy, 1997)

5.3 Program Activities

Table 11-71 shows the program activities at the Terminal Ballistics Facility.

Table 11-71. Program Activities at the Terminal Ballistics Facility

Program Name	Activities at the Terminal Ballistics Facility	Category of Program	Related Section of the SNL Institutional Plan
Direct Stockpile Activities	Conduct environmental, safety, and survivability testing for nuclear weapon applications.	Programs for the Department of Energy	Section 6.1.1.1
Special Projects	The DOE/DoD munitions memorandum of understanding is a cooperative, jointly funded research and development effort between the DOE and DoD to exploit and transfer the technology base resident at the DOE National Laboratories for the development of advanced, cost-effective, nonnuclear munitions. Areas of mutual interest to both DOE and DoD include the reduction of operational hazards associated with energetic materials, advanced initiation and fuse development, munitions lifecycle engineering, hard target penetration, and computer simulation.	Programs for the Department of Energy	Section 6.1.1.1
System Components Science and Technology	Conduct terminal ballistics impact testing to evaluate materials response.	Programs for the Department of Energy	Section 6.1.1.1
Sustaining Critical Progress in Model Validation	Validate codes related to penetration (for example, for shipping containers and storage bunkers).	Major Programmatic Initiatives	Section 7.1.3

5.4 Operations and Capabilities

Normal operations at the Terminal Ballistics Facility include the following:

- Firing of all types of firearms
- Assembly of propellant charges
- Hand loading of ammunition
- Handling and testing of explosives

Indoor testing of firearms and projectiles is conducted from a fixed firing stand to provide controlled firing of ammunition up to 20 mm in size. Tests are initiated remotely from the control room. All projectiles and fragments are contained in the firing range room. Data from tests in the indoor firing range is collected in the control room.

The 155-mm gun may be used for projectile or penetration tests with targets up to about 1,000 ft to the south of Building 6750. Tests are initiated remotely from the control room. Data collection typically includes video and post-firing analysis of projectiles or targets.

For outdoor thrust tests, a rocket is attached to the static test stand in a vertical orientation with the nose resting on a load cell. The thrust force is measured during the propellant burn cycle. Spin rockets are also tested using a horizontal test fixture with an integral load cell. Tests are initiated remotely from the control room. Data from tests is collected in the control room.

Testing of munitions may also be done outdoors in explosive-rated chambers. These tests may include both explosives and chemicals. Tests are initiated remotely from the control room, and data from these tests are collected in the control room.

(U.S. Department of Energy, 1997)

5.5 Hazards and Hazard Controls

Hazards at the Terminal Ballistics Facility that are related to handloading of cartridges and the loading and discharging of firearms are considered routine industrial hazards.

Other hazards at this facility include the following:

- Grass fires started from hot projectiles, flak, or shrapnel
- Flak and shrapnel
- Large projectiles, which are launched in some tests in the outdoor range
- Rocket motors that are tested on the static-firing stand and a horizontal test fixture
- Explosives, which are used in reactive targets, in rocket motors, or as part of an assembled component
- Chemicals use in munitions tests

High noise levels are produced by the discharge of firearms and the large-caliber outdoor gun and by the firing of rocket motors.

Highly flammable material at the facility includes the following:

- Acetone
- Methanol

Hazard controls at the Terminal Ballistics Facility include the following:

- Fire-fighting equipment and procedures are evaluated and implemented for each outside test. For example, fire extinguishers may be provided to use in case of a grass fire.
- Targets are designed to absorb or deflect flak or shrapnel whenever possible, and the hazard radius associated with the test event, including the flak and shrapnel range, is calculated before the testing.
- Earth berms serve as a backstop for large projectiles whenever possible.
- Because large projectiles pose a hazard to personnel in the area of testing, the area is barricaded and inspected prior to firing of any shot. No facilities within the hazard radius are endangered.
- Before each rocket motor test, procedures for visual inspections and lockout barricades are followed to ensure that the hazard radius, which is determined before testing activities, is clear of personnel. Hazard radii fall within Tech Area III, precluding the possibility of accidental landing in populated areas.
- Tests involving explosives use those explosives in very small quantities, and personnel are not permitted within the hazard radius, which is determined before testing activities, while the tests take place.
- Firearms are fired by remote control from a shielded control room to ensure operational safety. Firearms are not routinely discharged by hand-held techniques.
- Personnel are trained in the following:
 - Firing of firearms
 - Hand loading ammunition
 - Assembly of propellant charges
 - Handling of explosives
 - Handling of chemicals

- Personnel follow standard safety practices for propellant handling and the reloading and firing of firearms.
- Cleaners and solvents are stored in approved and appropriate storage cabinets.
- Workers are protected from high noise levels from firearms by the enclosed, shielded room where tests take place, and workers in adjacent facilities and transient personnel are kept at a safe distance by fixed barricades and warning lights during testing operations. Workers also wear ear protective devices as required by operating procedures.
- Hazardous chemicals that are used in munition tests are staged in only the quantities necessary to support a one- or two-week test series.
- PPE is provided as appropriate for the tests that are conducted.
- Chemical waste management personnel remove hazardous waste, including oily rags, solvents, lead-contaminated sand, residue explosives, residue spray paints, and adhesives.

(U.S. Department of Energy, 1994)

5.6 Accident Analysis Summary

The Terminal Ballistics Facility has been found to be a low-hazard nonnuclear facility by the SNL primary hazard screening process and does not require a safety analysis report. A follow-up hazards analysis is planned but is not expected to change the earlier finding.

5.7 Reportable Events

The Terminal Ballistics Facility has had no occurrences over the past five years.

5.8 Scenarios for Impact Analysis

In all of the scenarios for impact analysis in this section, base year values are for FY1996 unless otherwise noted.

5.8.1 Activity Scenarios

5.8.1.1 Scenario for Test Activities: Projectile Impact Testing

5.8.1.1.1 Alternatives for Test Activities: Projectile Impact Testing

Table 11-72 shows the alternatives for projectile impact testing at the Terminal Ballistics Facility.

Table 11-72. Alternatives for Test Activities: Projectile Impact Testing

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
10 tests	50 tests	80 tests	100 tests	350 tests

5.8.1.1.2 Assumptions and Actions for the “Reduced” Values

Projectile impact tests include all calibers of projectiles, from small arms to the 155-mm gun. Projections under the “reduced” alternative assume maintenance of the minimum capability for supporting ongoing development of the safe-secure transport, which is used for transport of nuclear weapons. Projections further assume little to no support to Work for Others programs or Laboratory-Directed Research and Development initiatives. Staffing levels would be anticipated to remain much the same as those projected for the base year.

5.8.1.1.3 Assumptions and Rationale for the “No Action” Values

The base year for testing at the Terminal Ballistics Facility is FY1997. Currently, the facility is operated in a campaign mode (test are performed in response to customer demands). The facility is not staffed full time.

The operating level for the FY2003 and FY2008 values assumes minimal increases in activity; specifically, they assume only the minimum in additional support to Work for Others programs and Laboratory-Directed Research and Development initiatives. No additional capabilities would be required or new activities anticipated. Staffing levels would be anticipated to remain much the same as those of the 1997 base year.

5.8.1.1.4 Assumptions and Actions for the “Expanded” Values

The “expanded” alternative assumes maximum utilization of the facility. This would include major increases in Work for Others support and a greater level of effort in support of Laboratory-Directed Research and Development initiatives. No additional capabilities or new

activities would be anticipated, and staffing levels would be expected to remain the same as those projected for the base year.

5.8.1.2 Scenario for Test Activities: Propellant Testing

5.8.1.2.1 Alternatives for Test Activities: Propellant Testing

Table 11-73 shows the alternatives for propellant testing at the Terminal Ballistics Facility.

Table 11-73. Alternatives for Test Activities: Propellant Testing

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
4 tests	25 tests	40 tests	50 tests	100 tests

5.8.1.2.2 Assumptions and Actions for the “Reduced” Values

Propellant testing includes static thrust tests and tests of spin rockets. The projection provided under the “reduced” alternative assumes maintaining the minimum capability required to support ongoing development of the safe-secure transport. In addition, the “reduced” alternative assumes little to no support to Work for Others programs and no Laboratory-Directed Research and Development initiatives. Staffing levels under this alternative would be anticipated to remain much the same as those of the 1996 base year.

5.8.1.2.3 Assumptions and Rationale for the “No Action” Values

The assumptions for the “no action” alternative are the same as those for projectile impact testing. Base year values are 1996 actuals. Similar to the assumptions applied for projectile impact testing, projections for the FY2003 and FY2008 timeframes assume only minimal increases in activity and minimum additional success in Work for Others and Laboratory-Directed Research and Development initiatives.

5.8.1.2.4 Assumptions and Actions for the “Expanded” Values

The “expanded” alternative assumes maximum utilization of the facility. This would include major increases in Work for Others support and Laboratory-Directed Research and Development initiatives. However, no new capabilities would be required and no new activities anticipated. As with projections under other alternatives, staffing levels would be anticipated to remain much the same.

5.8.2 Material Inventories

5.8.2.1 Nuclear Material Inventory Scenarios

The Terminal Ballistics Facility has no nuclear material inventories.

5.8.2.2 Radioactive Material Inventory Scenarios

The Terminal Ballistics Facility has no radioactive material inventories.

5.8.2.3 Sealed Source Inventory Scenarios

The Terminal Ballistics Facility has no sealed source inventories.

5.8.2.4 Spent Fuel Inventory Scenarios

The Terminal Ballistics Facility has no spent fuel inventories.

5.8.2.5 Chemical Inventory Scenarios

The Terminal Ballistics Facility has no inventories of chemicals of concern.

5.8.2.6 Explosives Inventory Scenarios

5.8.2.6.1 Explosives Inventory Scenario for Bare UNO 1.3

Alternatives for Bare UNO 1.3 Explosives Inventory - Table 11-74 shows the alternatives for the bare UNO 1.3 explosives inventory at the Terminal Ballistics Facility.

Table 11-74. Alternatives for Bare UNO 1.3 Explosives Inventory

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
15,000 g	20,000 g	20,000 g	20,000 g	25,000 g

Operations That Require Bare UNO 1.3 - Projectile impact testing uses UNO 1.3 explosives. These are generally primers and propellants used to fabricate or propel projectiles or fuel for solid-fuel rocket motors.

Basis for Projecting the “Reduced” and “Expanded” Values - The level of inventory generally remains stable over a wide range of operating scenarios. Projections under both the “reduced” and “expanded” alternatives assume only nominal decreases and increases for those scenarios.

5.8.2.6.2 Explosives Inventory Scenario for Bare UNO 1.4

Alternatives for Bare UNO 1.4 Explosives Inventory - Table 11-75 shows the alternatives for bare UNO 1.4 explosives inventory at the Terminal Ballistics Facility.

Table 11-75. Alternatives for Bare UNO 1.4 Explosives Inventory

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
15,000 g	20,000 g	20,000 g	20,000 g	24,000 g

Operations That Require Bare UNO 1.4 - Projectile impact testing uses UNO 1.4 explosives. These are generally primers and propellants used to fabricate or propel projectiles or fuel for solid-fuel rocket motors.

Basis for Projecting the “Reduced” and “Expanded” Values - The level of inventory remains generally stable over a wide range of operating scenarios. Projections under both the “expanded” and “reduced” alternatives reflect only nominal increases and decreases in inventory for these scenarios.

5.8.2.6.3 Explosives Inventory Scenario for Bare UNO 1.1

Alternatives for Bare UNO 1.1 Explosives Inventory - Table 11-76 shows the alternatives for the bare UNO 1.1 inventory at the Terminal Ballistics Facility.

Table 11-76. Alternatives for Bare UNO 1.1 Explosives Inventory

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
19 kg	19 kg	20 kg	20 kg	25 kg

Operations That Require Bare UNO 1.1 - Projectile impact testing uses UNO 1.1 explosives. These are generally electric primers used to fabricate projectiles.

Basis for Projecting the “Reduced” and “Expanded” Values - The level of inventory remains generally stable over a wide range of operating scenarios. Projections under both the

“expanded” and “reduced” alternatives reflect only nominal increases and decreases in inventory for these scenarios.

5.8.2.6.4 Explosives Inventory Scenario for Bare UNO 1.2

Alternatives for Bare UNO 1.2 Explosives Inventory - Table 11-77 shows the alternatives for bare UNO 1.2 explosives inventory at the Terminal Ballistics Facility.

Table 11-77. Alternatives for Bare UNO 1.2 Explosives Inventory

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
5 kg	8 kg	8 kg	8 kg	10 kg

Operations That Require Bare UNO 1.2 - Projectile impact testing uses UNO 1.2 explosives. These are generally primers used to fabricate projectiles.

Basis for Projecting the “Reduced” and “Expanded” Values - The level of inventory remains generally stable over a wide range of operating scenarios. Projections under both the “expanded” and “reduced” alternatives reflect only nominal increases and decreases in inventory for these scenarios.

5.8.2.7 Other Hazardous Material Inventory Scenarios

The Terminal Ballistics Facility has no inventories of hazardous materials that do not fall into the categories of nuclear or radioactive material, sealed sources, spent fuel, explosives, or chemicals.

5.8.3 Material Consumption

5.8.3.1 Nuclear Material Consumption Scenarios

Nuclear material is not consumed at the Terminal Ballistics Facility.

5.8.3.2 Radioactive Material Consumption Scenarios

Radioactive material is not consumed at the Terminal Ballistics Facility.

5.8.3.3 Chemical Consumption Scenarios

Information initially provided for this section resides in the Facility Information Manager database and will be made available to the analysts responsible for preparing the sitewide environmental impact statement.

5.8.3.4 Explosives Consumption Scenarios

5.8.3.4.1 Explosives Consumption Scenario for Bare UNO 1.1 Explosives

Alternatives for Bare UNO 1.1 Explosives Consumption - Table 11-78 shows the alternatives for bare UNO 1.1 explosives consumption at the Terminal Ballistics Facility.

Table 11-78. Alternatives for Bare UNO 1.1 Explosives Consumption

Reduced Alternative		No Action Alternative						Expanded Alternative	
		Base Year		FY2003		FY2008			
1 pkgs	0.4 kg	4 pkgs	2 kg	8 pkgs	3.2 kg	8 pkgs	4 kg	28 pkgs	14 kg

Operations That Require Bare UNO 1.1 Explosives - Projectile impact testing uses UNO 1.1 explosives. These are generally electric primers used to fabricate projectiles. Explosive packages delivered to the test site range in quantity from 1 g to 1 kg. An approximate average package size would be 500 g.

Basis for Projecting the “Reduced” and “Expanded” Values - The consumption of UNO 1.1 explosives, while not directly proportional to the number of projectile impact tests, is related to the number of tests.

5.8.3.4.2 Explosives Consumption Scenario for Bare UNO 1.2 Explosives

Alternatives for Bare UNO 1.2 Explosives Consumption - Table 11-79 shows the alternatives for bare UNO 1.2 explosives consumption at the Terminal Ballistics Facility.

Table 11-79. Alternatives for Bare UNO 1.2 Explosives Consumption

Reduced Alternative		No Action Alternative						Expanded Alternative	
		Base Year		FY2003		FY2008			
1 pkgs	0.6 kg	6 pkgs	3 kg	10 pkgs	4.8 kg	12 pkgs	6 kg	42 pkgs	21 kg

Operations That Require Bare UNO 1.2 Explosives - Projectile impact testing uses UNO 1.2 explosives. These are generally primers used to fabricate projectiles. Explosive packages

delivered to the test site range in quantity from 1 g to 1 kg. An approximate average package size would be 500 g.

Basis for Projecting the “Reduced” and “Expanded” Values - The consumption of UNO 1.2 explosives, while not directly proportional to the number of projectile impact tests, is related to the number of tests.

5.8.3.4.3 Explosives Consumption Scenario for Bare UNO 1.3 Explosives

Alternatives for Bare UNO 1.3 Explosives Consumption - Table 11-80 shows the alternatives for bare UNO 1.3 explosives consumption at the Terminal Ballistics Facility.

Table 11-80. Alternatives for Bare UNO 1.3 Explosives Consumption

Reduced Alternative		No Action Alternative						Expanded Alternative	
		Base Year		FY2003		FY2008			
1 pkgs	0.4 kg	2 pkgs	2 kg	6 pkgs	3.2 kg	8 pkgs	4 kg	28 pkgs	14 kg

Operations That Require Bare UNO 1.3 Explosives - Projectile impact testing uses UNO 1.3 explosives. These are generally primers and propellants used to fabricate or propel projectiles. Explosive packages delivered to the test site range in quantity from 1 g to 1 kg. An approximate average package size would be 500 g.

Basis for Projecting the “Reduced” and “Expanded” Values - The consumption of UNO 1.3 explosives, while not directly proportional to the number of projectile impact tests, is related to the number of tests.

5.8.3.4.4 Explosives Consumption Scenario for Bare UNO 1.4 Explosives

Alternatives for Bare UNO 1.4 Explosives Consumption - Table 11-81 shows the alternatives for bare UNO 1.4 explosives consumption at the Terminal Ballistics Facility.

Table 11-81. Alternatives for Bare UNO 1.4 Explosives Consumption

Reduced Alternative		No Action Alternative						Expanded Alternative	
		Base Year		FY2003		FY2008			
1 pkgs	0.4 kg	4 pkgs	2 kg	6 pkgs	3.2 kg	8 pkgs	4 kg	28 pkgs	14 kg

Operations That Require Bare UNO 1.4 Explosives - Projectile impact testing and propellant testing use UNO 1.4 explosives. These generally include primers and propellants used to fabricate projectiles or propel projectiles and fuel for solid-fuel rocket motors. Explosive

packages delivered to the test site range in quantity from 1 g to 1 kg. An approximate average package size would be 500 g.

Basis for Projecting the “Reduced” and “Expanded” Values - The consumption of UNO 1.4 explosives, while not directly proportional to the number of propellant and projectile impact tests, is related to the number of tests.

5.8.4 Waste

5.8.4.1 Low-Level Radioactive Waste Scenario

Low-level radioactive waste is not produced at the Terminal Ballistics Facility.

5.8.4.2 Transuranic Waste Scenario

Transuranic waste is not produced at the Terminal Ballistics Facility.

5.8.4.3 Mixed Waste

5.8.4.3.1 Low-Level Mixed Waste Scenario

Low-level mixed waste is not produced at the Terminal Ballistics Facility.

5.8.4.3.2 Transuranic Mixed Waste Scenario

Transuranic mixed waste is not produced at the Terminal Ballistics Facility.

5.8.4.4 Hazardous Waste Scenario

5.8.4.4.1 Alternatives for Hazardous Waste at the Terminal Ballistics Facility

Table 11-82 shows the alternatives for hazardous waste at the Terminal Ballistics Facility.

Table 11-82. Alternatives for Hazardous Waste

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
0 kg	0.25 kg	0.50 kg	0.50 kg	0.75 kg

5.8.4.4.2 Operations That Generate Hazardous Waste

The operations with the potential to generate hazardous waste at the Terminal Ballistics Facility include test preparation, cleanup, and the destruction of explosives components.

5.8.4.4.3 General Nature of Waste

The hazardous waste residuals include oily rags, solvents, lead-contaminated sand, explosives residue, spray paint residue, and residues from adhesives.

5.8.4.4.4 Waste Reduction Measures

The generation of hazardous waste as a result of these operations is minimal. However, operations at the Terminal Ballistics Facility routinely implement SNL/NM-mandated waste minimization practices, which include the use of environmentally friendly cleansers and offsite disposal of waste through the Hazardous Waste Management Facility.

5.8.4.4.5 Basis for Projecting the “Reduced” and “Expanded” Values

The Terminal Ballistics Facility generates less than 1 kg of hazardous waste annually. The generation of this waste is not proportional to activity levels. As a result, the projections of hazardous waste generated are based only on the assumption that little to no waste would be generated under the “reduced” alternative and that only an incremental increase would be anticipated under the “expanded” alternative.

5.8.5 Emissions

5.8.5.1 Radioactive Air Emissions Scenarios

Radioactive air emissions are not produced at the Terminal Ballistics Facility.

5.8.5.2 Chemical Air Emissions

Information on an extensive list of chemicals was obtained from the SNL/NM Chemical Inventory System (CIS). For the air emissions analysis, the entire annual inventory of these chemicals was assumed to have been released over a year of operations for each specific facility (i.e., the annual inventory was divided by facility operating hours). The emissions from this release were then subjected, on a chemical-by-chemical basis, to a progressive series of screening steps for potential exceedances of both regulatory and human health thresholds. For those chemicals found to exceed this screening, process knowledge was used to derive

emission factors. The emission factors for these chemicals were then modeled using the U.S. Environmental Protection Agency's *Industrial Source Complex Air Quality Dispersion Model, Version 3*. The results of this modeling are discussed as part of the analysis in support of the SNL/NM site-wide environmental impact statement.

5.8.5.3 Open Burning Scenarios

The Terminal Ballistics Facility does not have outdoor burning operations.

5.8.5.4 Process Wastewater Effluent Scenario

The Terminal Ballistics Facility does not generate process wastewater.

5.8.6 Resource Consumption

5.8.6.1 Process Water Consumption Scenario

The Terminal Ballistics Facility does not consume process water.

5.8.6.2 Process Electricity Consumption Scenario

The Terminal Ballistics Facility does not consume process electricity.

5.8.6.3 Boiler Energy Consumption Scenario

The Terminal Ballistics Facility does not consume energy for boilers.

5.8.6.4 Facility Personnel Scenario

5.8.6.4.1 Alternatives for Facility Staffing at the Terminal Ballistics Facility

Table 11-83 shows the alternatives for facility staffing at the Terminal Ballistics Facility.

Table 11-83. Alternatives for Facility Staffing

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
0.05 FTEs	0.3 FTEs	0.4 FTEs	0.6 FTEs	2 FTEs

5.8.6.4.2 Operations That Require Facility Personnel

All operations at the facility require personnel. Due to the intermittent nature of operations, the Terminal Ballistics Facility full-time staffing levels remain low. Because the facility operates in a campaign mode (used on customer demand), additional staffing needs are often met by other SNL/NM facilities on an as-needed basis. The categories of personnel required in support of Terminal Ballistics Facility operations primarily include engineers, technicians, and trained staff.

5.8.6.4.3 Staffing Reduction Measures

No staffing reduction measures exist.

5.8.6.4.4 Basis for Projecting the “Reduced” and “Expanded” Values

The partial FTEs are intended to reflect levels of effort in operational man hours. For example, the 0.05 of an FTE identified under the “reduced” alternative represents a level of effort equivalent to around 80 to 100 hours, or approximately two man-weeks. The expanded staffing level is consistent with the facility's testing capacity.

5.8.6.5 Expenditures Scenario

5.8.6.5.1 Alternatives for Expenditures at the Terminal Ballistics Facility

Table 11-84 shows the alternatives for expenditures at the Terminal Ballistics Facility.

Table 11-84. Alternatives for Expenditures

Reduced Alternative	No Action Alternative			Expanded Alternative
	Base Year	FY2003	FY2008	
\$3,000	\$8,500	\$9,500	\$11,000	\$12,000

5.8.6.5.2 Operations That Require Expenditures

All operations require expenditures to maintain the facility.

5.8.6.5.3 Expenditure Reduction Measures

No expenditure reduction measures exist.

5.8.6.5.4 Basis for Projecting the “Reduced” and “Expanded” Values

There is a core of operating costs incurred regardless of the level of testing. Therefore, the costs estimated for the “reduced” and “expanded” alternatives are not proportional to the level of testing.

6.0 REFERENCES

6.1 Regulations, Orders, and Laws

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